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Consumers' Intention Toward Using Bio-Based Plastic Products – Extending the Theory of Planned Behaviour

Master Thesis

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Sustainable Management

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Abstract (English Version)

The use of plastic as a material has significant negative impacts on the environment such as the presence of microplastic and the increased usage of the finite resource crude oil for plastic production. To reduce this negative impact, several pathways to improving plastic circularity have been introduced. One such way is to produce plastic from biomass, so-called bio-based plastic. These materials are not widely distributed yet, relatively unknown by the general public, and in comparison to conventional plastic often more expensive. This master thesis investigates factors that influence consumers' attitude toward and intention to use bio-based plastic products within the framework of the Theory of Planned Behaviour (TPB). It employed empirical research in form of a survey using a sample of 184 people over 16 years of age. The model and its hypotheses were tested by two multiple linear regression models using four variables derived from the literature review and two mediation analyses. It was found that the additional variables "Green consumer values" and "Trust" had significant positive effects on Attitude toward bio-based plastic products. In addition, the variables "Green consumer values", "Subjective norm", "Attitude", and "Perceived consumer effectiveness" had significant positive effects on Intention to use bio-based plastic products. Attitude was further found to be a mediator for Perceived consumer effectiveness and Green consumer values on Intention. The importance of Green consumer values influencing both attitude and intention leads to the conclusion that it can be used to extend the TPB. Additionally, the findings lead to several implications for marketing managers to take into account when developing social marketing campaigns for bio-based plastic products.

Abstract (Italian Version)

L'uso della plastica come materiale ha impatti negativi significativi sull'ambiente, come la presenza di microplastiche e l'aumento dell'uso della risorsa finita del petrolio greggio per la produzione di plastica. Per ridurre questo impatto negativo, sono stati introdotti diversi percorsi per migliorare la circolarità della plastica. Uno di questi è quello di produrre plastica dalla biomassa, la cosiddetta plastica biologica. Questi materiali non sono ancora ampiamente distribuiti, sono relativamente sconosciuti al grande pubblico e, rispetto alla platica convenzionale, sono spesso più costosi. Questa tesi di laurea magistrale indaga i fattori che influenzano l'atteggiamento e l'intenzione dei consumatori di utilizzare prodotti in plastica a base biologica nel quadro teorico della Teoria del Comportamento Pianificato (TPB dall'inglese Theory of Planned Behaviour). È stata utilizzata una ricerca empirica sotto forma di indagine utilizzando un campione di 184 persone di età superiore ai 16 anni. Il modello e le sue ipotesi sono stati testati con due modelli di regressione lineare multipla utilizzando quattro variabili derivate dalla revisione della letteratura e due analisi di mediazione. È emerso che le variabili aggiuntive "Valori del consumatore verde" e "Fiducia" hanno avuto effetti positivi significativi sull'atteggiamento verso i prodotti in plastica a base biologica. Inoltre, le variabili "Valori del consumatore verde", "Norma soggettiva", "Atteggiamento" ed "Efficacia percepita del consumatore" hanno avuto effetti positivi significativi sull'intenzione di utilizzare la plastica a base biologica. L'atteggiamento è stato inoltre trovato come mediatore per l'efficacia percepita del consumatore e per i valori del consumatore verde sull'intenzione. L'importanza dei valori dei consumatori verdi che influenzano sia l'atteggiamento che l'intenzione porta alla conclusione che possono essere utilizzati per estendere la TPB. Inoltre, i risultati portano a diverse implicazioni che i responsabili del marketing devono tenere in considerazione nello sviluppo di campagne di marketing sociale per i prodotti in plastica biologica.

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List of Abbreviations

LCA   Life-Cycle Assessment

PE   Polyethylene

PET   Polyethylene terephthalate

PP   Polypropylene

PVC   Polyvinylchloride

TPB   Theory of Planned Behaviour

TRA   Theory of Reasoned Action

USDA U.S. Department of Agriculture

VIF   Variance Influence Factor

WTP   Willingness-to-pay

List of Symbols

a   Direct effect independent variable on mediator in mediation analysis

ab   Indirect effect in the mediation analysis

α   Cronbach's Alpha for internal consistency

b   Direct effect mediator on independent variable in mediation analysis

β	Standardised beta coefficient
B	Regression coefficient
c	Total effect independent variable on dependent variable in the mediation analysis
c'	Direct effect independent variable on dependent variable in the mediation analysis
F	F-value
n	Sample size
M	Mediator (mediation analysis)
p	Probability value, significance value
R^2	Coefficient of determination, explained variance
SD	Standard Deviation
t	t-value
X	Independent variable (mediation analysis)
Y	Dependent variable (mediation analysis)

1. Introduction

1.1 Purpose

Plastic is an especially important material in our world today. It is applied in nearly every area of life, from technical and communication devices, medical devices, toys, sport equipment, product packaging, to food packaging. Most of the plastic used today is based on the finite resource fossil fuel with only a limited amount being recycled (Spierling et al., 2018).

The world is steadily increasing its demand for plastic, in accordance with its growth of GDP, population, and income levels. According to data from BloombergNEF, the demand by 2050 for the most common types of plastic, namely, PE (polyethylene), PP (polypropylene), and PET (polyethylene terephthalate), is expected to increase by 90% to 403 million metric tonnes. This number already excludes the amount of plastic which is saved by the introduction of restrictions in some countries on certain single-use plastic items, for example the countries of the EU and China. Since 2000, the demand for PE and PP has doubled (BloombergNEF, 2022). Globally, more than 380 million tonnes of plastic are produced every year, resulting in more plastic having been produced in the last ten years than in the entire 20th century. From this large number of increasing plastic production, only 9% is recycled with the rest being burned, sent to landfills, or being left in the natural environmental causing problems to wildlife and plants (European Climate, 2024). According to SYSTEMIQ (2022), this inefficiency leads to significant environmental impacts of 29 million tonnes of CO_2-equivalents in addition to economic costs of around €35-55 billion of material value for Europe annually (SYSTEMIQ, 2022).

This increasing production of plastic needs to be addressed as several problems arise due to it. These problems include the introduction of microplastic to the environment and the presence of plastic items in the environment due to their long existence without degradation. Moreover, the emissions produced alongside plastic production and the fact that the base of conventional

plastic is a finite resource arise as problems. In order to make the usage of plastic more sustainable, several measures can be followed. This includes the redesign of processes to reduce the total amount of plastic used, the collecting and reusing of materials, as well as recycling. One possibility is to replace conventional plastic with other types of materials that are more sustainable. This can include recycled plastic but only when it goes through several lifecycles with limited material loss and thus is used for a long time (Ellen MacArthur Foundation).

Still, addressing the problems surrounding plastic remains a challenge for the society. Currently, the amount of plastic that is reduced and recycled only refers to a limited amount (European Climate, 2024). But even with the improvement of these measures the problem of conventional plastic being based on finite resources and its environmental impacts remain. A solution to these specific problems regarding plastic are bio-based plastics. Bio-based plastics are made from renewable biomass which is essentially plants or bio-waste. Depending on the needed characteristics of the product, bio-based plastic offers different usage options and material types. Thus they are very similar to the spectrum conventional fossil-based plastic offers (European Bioplastics e.V., 2022). Spierling et al. (2018) estimate that for a substitution of two-thirds of global plastic demand by bio-based plastics, potentially 241 to 316 million tonnes of CO_2-equivalents could be saved annually. This is a substantial amount which would help in decreasing the environmental impacts of plastic production. Thus, under specific circumstances and production conditions, bio-based plastic is a viable alternative to conventional plastic (European Bioplastics e.V., 2023). The specific conditions and advantages will be further discussed within the section 2.2. Bio-Based Plastic as a Solution.

As bio-based plastic is a comparatively new material and several innovative types are still being developed and improved, it is relatively unknown to consumers and not widely distributed in the market. Consequently, consumers had little interaction with the material until now and whether, as well as under which conditions, they would use bio-based plastic products instead

of fossil-based plastic products is not well-established. Moreover, the intention to use bio-based plastic has been subjected to limited research (Gutiérrez-Taño et al., 2022).

The focus of this master thesis is thus to examine the factors which influence consumers' decision to use bio-based plastic products instead of the conventional plastic products made from fossil fuel. To assess the decision to use bio-based plastic products, the theoretical framework of the Theory of Planned Behaviour (TPB) of Izek Ajzen is employed, which includes the factors attitude, subjective norm, and perceived behavioural control to predict intention. Intention in turn is then the most immediate proxy for actual behaviour when the individual in in complete volitional control (Ajzen, 1991). Additionally, this master thesis develops a proposed research model which extends the TPB. This includes examining several factors – Green consumer values, Perceived consumer effectiveness, Habit, and Trust - influencing attitude toward bio-based plastic products based on the in previous literature well-proven assumption that a more positive attitude leads to higher intent in the field of using bio-based plastic products. Furthermore, the same factors and the original TPB constructs are evaluated on their influence on intention to use bio-based plastic products. The variables used to extend the TPB have been added in order to gain a better understanding of which consumer characteristics and factors explain attitude and intention to use bio-based plastic products in addition to the original factors of the TPB in order to assess the decision to adopt bio-based plastic products.

With this methodology and research focus this master thesis follows calls from the literature to investigate more green products, in this case the relatively new material bio-based plastic products, on the theoretical basis of TPB. By doing so, further research should take more relevant variables into account, assess their fit, and thereby extending the framework of the TPB (Paul et al., 2016). Additionally, this thesis investigates a previously limited research field

and thus deepens the understanding of consumer intentions to use bio-based plastic products (Gutiérrez-Taño et al., 2022; Morone et al., 2021).

The empirical study thus serves to answer the following primary research question: Which factors determine the decision to use bio-based plastic products?

The primary research question split up into more detailed questions leads to the following:

- Which variables influence the attitude toward bio-based plastic products?

- What are the main factors influencing intention to use bio-based plastic products?

1.2. Proceedings

In the following, the structure of this master thesis will be shortly introduced. The thesis starts in chapter 1 with the introduction and the proceedings of this master thesis.

Subsequently, in chapter 2, the problems of plastic production and plastic waste are outlined. Moreover, the material bio-based plastic will be introduced and defined, and the distinctions between different terms regarding bioplastics will be made. Afterwards, the advantages and disadvantages of bio-based plastic will be discussed in regard to alleviating the problems of increased plastic consumption. Lastly, the consumer awareness, perception, and knowledge regarding bio-based plastic products will be discussed.

Chapter 3 starts with the literature review and the introduction and discussion of the theoretical background of this master thesis, the TPB. Within this chapter the extensions made to the TPB will be discussed in individual subchapters. For each of the individual variables – Green consumer values, Perceived consumer effectiveness, Habit, and Trust, alongside the control variables Previous product experience, Gender, Age, Income, and Level of schooling - used in the later statistical analyses the findings of the literature and the resulting hypotheses will be discussed.

Chapter 4 includes an overview of the research objectives, the proposed research model, and the hypotheses examined within this master thesis. Additionally, this chapter details the choice of the research instrument, the structure of the measurements, the questionnaire design, and the survey implementation.

The analysis of the data is presented in chapter 5. This chapter comprises the preparation of the data, a more detailed examination of the data profile and the socio-demographic characteristics of the respondents, as well as an investigation of the more general perceptions of bio-based plastic products. Subsequently, the hypotheses are tested in two multiple linear regressions and additional mediation analyses are carried out.

In chapter 6, the findings are classified based on findings from the literature. Managerial implications are discussed in chapter 7, while chapter 8 informs about limitations and potential future approaches to further research. Lastly, chapter 10 provides a final conclusion summarising the findings of this master thesis. Finally, the bibliography and appendices are provided.

Within this master thesis, the uppercase spelling of the conceptual concepts refers to the specific factors assessed within the model of this master thesis. The italicised terms denote the actuals variables that are calculated and thus used within the analyses. Lastly, constructs written in lowercase refer to general references or mentions of these concepts outside of the context of the model.

2.   Problem Overview and Bio-Based Plastic as Potential Solution

2.1.   Environmental Problems Caused by Plastic

As could be seen in the introduction, plastic is an important part of our everyday life. Due to this reason, plastic production has taken on increasingly large scales. In 2022, 400.3 million

tonnes of plastic were produced globally which can be seen in the figure below depicting the percentage of plastic produced by polymer category. According to the data, the most produced polymer is PP (18.9%), followed by the various kinds of PE (14.1% and 12.2%), and PVC (Polyvinylchloride; 12.7%). All of these plastic types are made from fossil-based feedstocks (Plastics Europe AISBL, 2023).

Figure 1: Global plastics production in 2022 (by polymer)
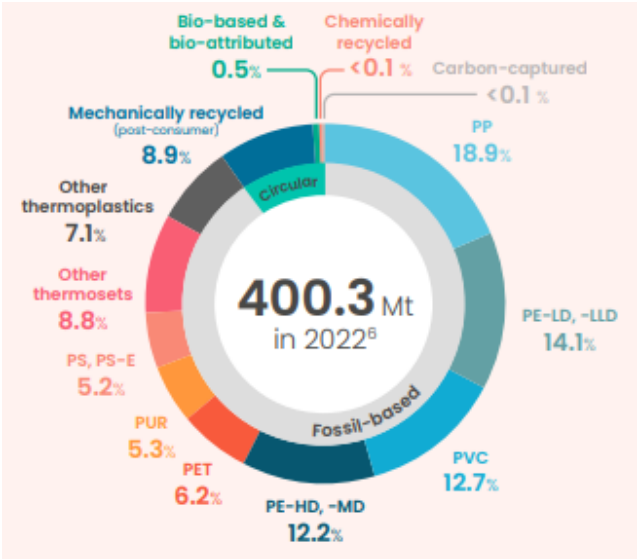
Source: Plastics Europe AISBL (2023)

As global demand for plastic continues to rise, so too does the necessity for the source material, crude oil. BloombergNEF estimates that the amount of oil used to make up the feedstock for conventional plastic could double until 2050, reaching to approximately 18 million barrels per day. The amount required for plastic production is equivalent to almost 20% of predicted total oil demand in 2050 (BloombergNEF, 2022). One of the problems using crude oil as a basis for plastic production is that crude oil is a finite resource. It needs to sustain the increasing usage for plastic production while also being one of the most important resources at the moment for other materials, especially as fuel for transportation. These usages all need to be sustained with a resource that is finite.

In addition to the increased usage of a limited source for plastic production, there is also the problem of increasing plastic waste. This is due to the most common consumption model being linear ("take-make-waste"). "Take-make-waste" refers to the way materials are taken in form of oil and gas, made into plastic products mostly designed to be used only once, to then be thrown away (Ellen MacArthur Foundation). This phenomenon has increased drastically due to the steadily rising need for packaging of products leading to the unsustainable use of a finite resource to be, in essence, disposed of.

Leakage of such plastic waste is an additional problem in the plastic cycle. While it is more so a problem in the less developed regions within Europe, it is a large problem in other regions of the world. Waste leakage can occur due to dumping, littering, and uncontrolled landfilling. It then collects in the landscape, is preserved over hundreds of years, and presents danger and waste to animal wildlife. Furthermore, developed countries have exported their waste to these countries over decades due to limited waste management capacities or financial constraints, thereby exacerbating the environmental challenges related to plastic waste in less economically developed countries (SYSTEMIQ, 2022). The presence of plastic material and plastic waste is also a large problem within the oceans. According to the Ellen MacArthur Foundation, 8 million tonnes of plastic leak into the oceans each year with increasing numbers. By 2050, this could result to there being more plastic in the oceans in weight than fish (Ellen MacArthur Foundation).

Lastly, with increasing plastic waste there is a growing volume of microplastics within nature. The term "microplastics" is typically used to describe small pieces of plastic, measuring less than 5 mm in size. Once distributed within nature, they are persistent and tend to accumulate. According to the EU, between 200 and 600 Olympic-size swimming pools of microplastics are unintentionally released each year. With the increasing presence of microplastics in the

environment, especially in the marine environment, concerns rise about their impact on the surroundings and human health (EU Directorate-General for Environment).

To reduce the impact of the problems of plastic, a complete shift of the economy is required. Products and the system itself need to be designed in a way that no material is lost or at least the amount lost is limited. This can be achieved by specific design of the products, by collecting and reusing, recycling, and composting the materials that are used. Additionally, some product materials can be biodegradable and as such would have less impact as waste on the environment. Moreover, some materials can be made from renewable sources instead of conventional sources in order to reduce consumption of fossil fuels (Ellen MacArthur Foundation). These measures are part of a more general shift of the consumption model towards a circular economy. A "circular economy is a system where materials never become waste and nature is regenerated" (Ellen MacArthur Foundation). Consequently, working towards a circular economy tackles climate change by reducing CO_2-emissions and additional environmental problems such as pollution, waste, and biodiversity loss. Thus, the circular economy requires a comprehensive transformation of the economic system by decoupling economic activity from the consumption of non-renewable resources such as fossil fuels utilised for plastic production (Ellen MacArthur Foundation). This is achieved by placing the economy on a foundation of renewable resources, and a reduction in waste production. Furthermore, the primary means of ensuring the longevity of materials is through the processes of reuse and recycling (Rosenboom et al., 2022).

Working towards the objective of circularity within the field of plastic, the EU has released several initiatives within the objective of moving towards a more sustainable economy such as the Waste Framework Directive of 2008, the Plastic Bags Directive from 2015, the Plastic Strategy from 2018, the Directive on Single-Use Plastic from 2019, a rework of the Packaging Directive, reworked rules on plastic waste shipments of 2023, and several initiatives regarding

microplastics. Moreover, a communication for an EU framework regarding biobased, biodegradable, and compostable plastics has been adopted in 2022. While this communication is not legally binding, there are two laws in place that indirectly impact bioplastics which are the Directive on single-use plastics and the Directive on plastic bags, banning the production and use of specific plastic products and requirements for those that are still produced. Currently, there is no definition or sustainability criteria that applies to bio-based plastic within the EU (EU Directorate-General for Environment).

The route towards a more sustainable plastic economy is certainly one that takes many different steps, from consumers who need to change their outlook on the usage of products, to producers who need to shift their production methods. Moreover, legislators need to facilitate this change by introducing incentive systems to increase adaption and by enacting legislation that prohibits certain materials completely or for specific purposes of usage, including the definition of mandatory targets limits for other materials.

One potential avenue for producers to pursue in order to manufacture plastic in a more environmentally conscious manner is to utilise renewable biomass as a feedstock in lieu of the conventional crude oil. The materials produced by this process are called bio-based plastic. Its definition and characteristics, also in demarcation to similar terms, will be discussed within the next section, 2.2. Bio-Based Plastics as a Solution.

While the production of these materials is already possible and feasible, the products made of these innovative materials need to be adopted by consumers. Consumers need to know about them and also recognise their advantages over other materials. In conjunction with other measures aimed at transforming the linear plastic economy, i.e. the reduction of plastic in general, to design products with more than one life-time in mind, and proper recycling as well as degrading mechanisms, the change toward bio-based feedstock to produce bio-based plastic can be one component on the way towards a more environmentally-friendly economy.

2.2. Bio-Based Plastic as a Solution

Bio-based plastics constitute a group of materials that form part of a larger product group, designated as bioplastics. The product category in question encompasses a multitude of diverse materials, which are frequently used in colloquial discourse as though they were synonymous. However, each of these materials possesses distinctive characteristics and applications. Frequently used terms within the field of bioplastics include bio-based plastic, biodegradable plastics, and compostable material. In the following, each of these terms will be defined according to the European Bioplastics e.V. (2022) in order to be more clear on what each term entails. These terms will be used in accordance with the following definitions within this master thesis.

Bio-based: Bio-based defines that the material or product is (at least in part) derived from biomass. Biomass in this case is a matter of plants which can be for example, corn, sugar cane, or wood. The material can be, but is not necessarily biodegradable (European Bioplastics e.V., 2022). As the base-material are plants or biowaste it is a relatively quickly renewable source, normally renewable once a year. Typically, a distinction of biomass is made between first-generation and second-generation feedstocks. First-generation feedstocks include materials such as corn, sugar cane, and edible vegetable oils, which can easily be fermented into bio-based polymers and are specifically grown for this usage. Second-generation feedstock is defined as being various non-edible biowastes which are widely available such as agricultural and food waste (Rosenboom et al., 2022).

Bio-degradable: A material is biodegradable when a material decomposes in a biochemical process in which microorganisms (such as bacteria, archaea, fungi, and algae) convert the base material into water, carbon dioxide, and biomass. This process only happens within specific environmental conditions, which necessitate a specific temperature, inoculum, and humidity, and only with specific materials (European Bioplastics e.V., 2022). The exact definition of

biodegradability and which conditions are necessary for a material to qualify as biodegradable are highly debated among researchers and practitioners as the term biodegradable does not define the temperatures, the duration under which the degradation happens, or the type of degradation as being aerobic or anaerobic (Herbes, 2021).

Compostable: When a material is compostable, it is able to biodegrade under industrial or home composting conditions (European Bioplastics e.V., 2022). This process results in the substances CO_2, H_2O, heat, and humus (Rosenboom et al., 2022).

A review of the definitions of the terms reveals that not all bioplastic is bio-degradable. Furthermore, while bio-based plastic can be biodegradable, it is not necessarily the case. The characteristic of being biodegradable depends on the chemical structure of the material instead of its source material which means that some fossil-based plastics can biodegrade under specific conditions (European Bioplastics e.V., 2022).

Typical material types according to European Bioplastics e.V. (2022) are:

1.) Bio-based or partly bio-based, non-biodegradable plastics such as polyethylene (PE), bio-based polypropylene (PP), or bio-based polyethylene terephthalate (PET), and technical performance polymers, such as bio-based polyamides (PA), polytrimethylene terephthalate (PTT), and new polymers, such as polyethylene furanoate (PEF);

2.) Plastics that are simultaneously bio-based and biodegradable such as polylactic acid (PLA) and polyhydroxyalkanoates (PHAs), polybutylene succinate (PBS), or other starch blends;

3.) Plastics that are fossil-based but are biodegradable, such as polybutylene adipate terephthalate (PBAT), that in some cases are already produced partly with bio-based feedstock.

In figure 2 an overview of different bioplastic materials categorised along their bio-based nature and their ability to bio-degrade is presented.

Figure 2: Bioplastics categorisation
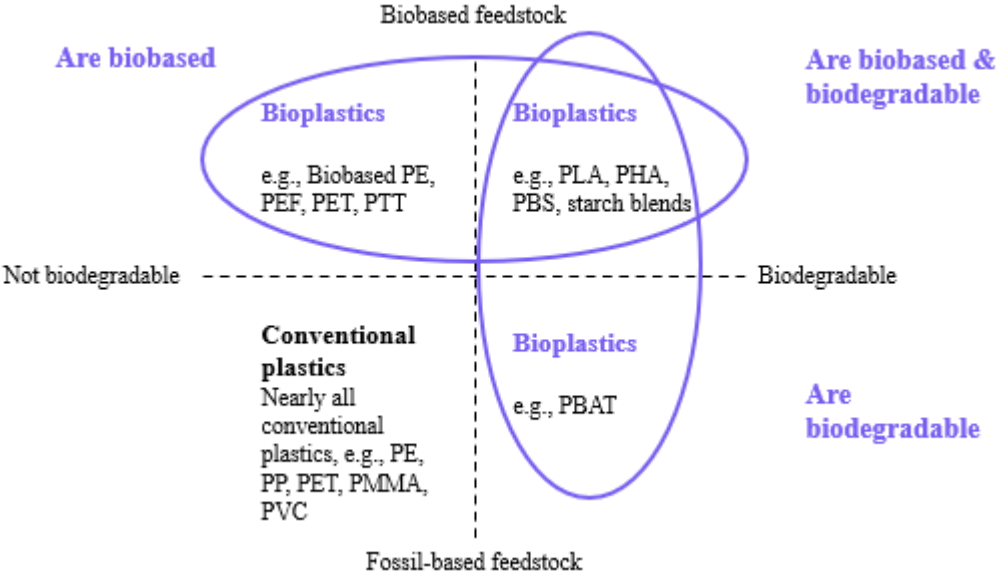
Source: European Bioplastics e.V. (2022)

In the following, some of the properties of bio-based plastic and its potential for reducing the environmental impact of plastic will be discussed. Depending on the type of bio-based plastic, they can make a positive impact on the environment by improving circularity. This happens by using renewable resources which are not fossil-based, have a reduced carbon footprint, in case of biodegradability an alternative end-of-life option, and depending on the material, improved material properties (Rosenboom et al., 2022).

The first potential advantage of bio-based plastics is the possibility to increase resource efficiency by the possibility of cascade use. The biomass needed can first be used for plastic products and materials that can be reused and recovered. The remaining material at the end-of-life of these products can be used for energy production, as biomass is already often used in the energy market for this purpose. Additionally, for products that cannot be replaced by bio-based material, more fossil-based material is available when other fossil-based plastic uses are replaced by bio-based plastic material solutions (European Bioplastics e.V., 2022).

The second advantage of bio-based plastic is the reduction of the carbon footprint and greenhouse gas emissions of materials and products (European Bioplastics e.V., 2022). This is especially the case as the reduced environmental footprint of bio-based plastics in comparison to fossil-based plastic lies more at the beginning of its life (Rosenboom et al., 2022). In a meta-analysis of Life-cycle assessments (LCA) regarding bio-based materials, Weiss et al. (2012) found that bio-based materials have lower environmental impacts in the category of climate change.

The third advantage of bio-based plastic materials is that when further developed, they may have a positive impact on the problem of increasing food-waste in some areas of the world. Food-waste management is a significant economic and sustainability problem and needs to be addressed by scholars, governments, and companies around the world. If the biomass representing the feedstock for bio-based plastic is made of food-waste, the food-waste arising from agriculture and home consumption could be used in a more sustainable manner (Scarpi et al., 2021).

The fourth advantage is a more political one. By substituting fossil-based plastic for bio-based plastics, the need for fossil resources is reduced and as such the necessity of importing them from other countries and thus being dependent on their exports is reduced. This geo-political advantage of bio-based sources is only viable if the biomass needed for the bio-based plastic production is grown stateside and not imported from outside the country (European Bioplastics e.V., 2022).

From a critical standpoint, bio-based plastic in itself is not by default more sustainable than fossil-based plastic as several problems arise with its production and use. The first problem regarding acceptance in the market and the development of more sustainable options by producers is that bioplastics in general are more expensive to produce. This is due to the missing economies of scale and the price disadvantages compared to crude oil (Rosenboom et al., 2022).

Secondly, the process to produce bioplastic materials can be more energy intensive than conventional plastic production. Moreover, when the bio-based plastic is based on primary feedstock, the agricultural farming and its associated burdens on the environment can erase the otherwise resulting reductions of environmental burdens (Rosenboom et al., 2022). Furthermore, during the production of bio-based plastic there may be negative consequences on the environment such as air pollution, acidification, water pollution, and eutrophication (Mendes & Pedersen, 2021).

The third problem presents itself regarding the end-of-life of specifically bio-based plastic products. As defined above, bio-based does not necessarily mean that the material is also biodegradable which results in difficulty disposing properly of them. Bio-based plastics can be recycled alongside their conventional counterparts in the respective recycling streams, e.g. biobased PET in the PET stream) (European Bioplastics e.V., 2023). For the most part, established recycling streams do not exist yet, confusion of consumers is high over where to dispose of the different materials, and compostable plastics are often not accepted by composting facilities (Rosenboom et al., 2022).

Fourth, bio-based plastic is often produced by first generation biomass which could also be used for food or feed production (Rosenboom et al., 2022). An often expressed criticism against bio-based materials is the resulting competition and ethical problem (Blesin et al., 2017; Rumm, 2016) as the increased need for first-generation biomass to fulfil the needs of food production and eventual production for bio-based plastics may lead to increased need of cultivated land. Additionally, the cultivated plant species, the cultivation intensity, and former land use are decisive in the impact of the production of biomass (Scherer et al., 2017). In response, the industry-oriented organisation European Bioplastics asserts that in 2022, 0.8 million hectares of land were required to produce the renewable feedstock of 2.2 million tonnes for all bioplastics, representing 0.015% of global agricultural area, which totals 5 billion hectares.

Consequently, the organisation claims that there is no competition between bioplastic production and the production of food and animal feed (European Bioplastics e.V., 2023). In contrast, second-generation biomass is considered to be burden-free and as such would perform better in the assessment of its environmental impact through a LCA (Mendes & Pedersen, 2021). Until now, there is little progress on how to use second-generation biomass, or biowastes that already have fulfilled their primary purpose to reduce the competition with food production (Rosenboom et al., 2022). In order to define the actual environmental footprint of bio-based plastics there need to be more studies in depth regarding the life-cycle of the material. This can be done via LCAs which determine a material's environmental impact across its whole lifecycle, from sourcing to disposal.

Lastly, there is the problem that the whole category of bioplastics is comparatively unknown to consumers. As of right now, education regarding advantages and disadvantages is lacking, no consistent labelling of the materials exists, and companies may express untruthful or exaggerating claims regarding their products' bio-based nature and their impacts which can be determined as greenwashing (Rosenboom et al., 2022).

As discussed above, bio-based plastics are not definitely more sustainable than fossil-based plastics but are seen as beneficial in reducing global warming through their usage of non-finite resources in many studies. Whether a bio-based plastic material is superior in environmental impacts to its fossil-based competitor is dependent on several factors and thus is context-dependent. As such, the superiority of bio-based plastic needs to be evaluated on a case-by-case basis, on the type of materials, and their various use cases (Herbes, 2021). Especially the use of first-generation feedstock for the production of the material and its agricultural environmental footprint lead to substantial impact on the environment (Rosenboom et al., 2022). Additionally, its end-of-life treatment is definitive in the overall environmental impact of bio-based plastic products. Nevertheless, Rosenboom et al. (2022) argue that bio-based replacements are already

available for most of the applications in which conventional plastic is used even if their production is mostly at a small scale and comparatively costly. In 2022, only 0.4 million tonnes of plastic produced in Europe were bio-based compared to 47.2 million tonnes fossil-based plastic. Over half of the bio-based plastic was produced in Germany as can be seen in figure 3 below (Plastics Europe AISBL, 2023).

Figure 3: Bio-based plastics production in Europe – Distribution by country
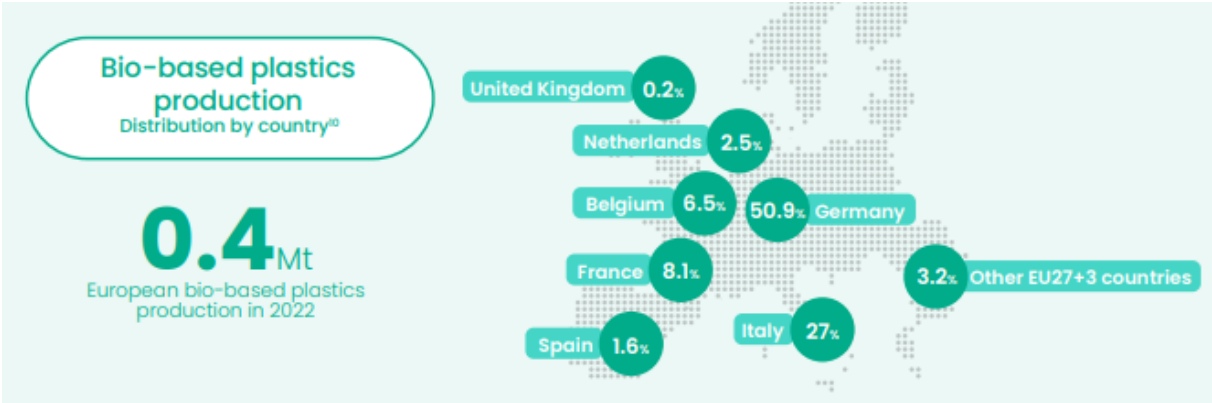
Source: Plastics Europe AISBL (2023)

Globally, 0.5% of a total of 400.3 million tonnes of the plastic produced in 2022 was bio-based or bio-attributed (Plastics Europe AISBL, 2023). According to the numbers of European Bioplastics, the largest market segment in which bio-based plastic was used in 2022 was flexible packaging with 27%, followed by fibres (26%), rigid packaging (15%), and consumer goods (10%) with electrics and electronics, coating and adhesives, agriculture and horticulture as well as other market segments making up the remaining 22% (European Bioplastics e.V., 2023).

Below, some examples of products made of bio-based plastic are shown. They include children's toys, plastic foil for agriculture, and sports equipment among other usage possibilities.

Image 1: LEGO figure made of bio-PE
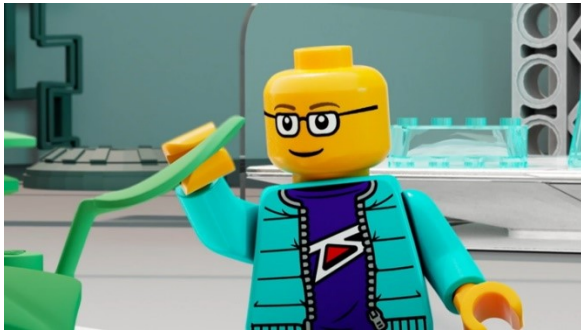
Image 2: BASF's soil-biodegradable ecovio® for mulch films with bio-based content

Source: 1

Source: 2

Image 3: VAUDE backpack made from bio-based material

Source: 3

Even if at this point in time production is low, there are constant improvements in the industry to increase the fit of material characteristics and usage possibilities. Especially the development of second-generation biomass as a way of reducing food waste is a promising pathway of development. Additionally, in combination with the compostability or recyclability characteristics, the materials can be used to increase circularity by reusing the base material. In order to achieve sustainable bio-based material, substantial investments in development need to be made. To assess where these developments need to be made, LCAs should be deployed to see where the largest environmental impacts of the production of bio-based plastic products are located, and how to decrease them. If these decreases in environmental impacts are achieved,

bio-based plastics are a viable pathway in turning the plastic sphere more sustainable in an effort to shift the economy towards a circular economy (Rosenboom et al., 2022). Although some of the reduced environmental impacts and thus advantages of bio-based plastics are only present under certain conditions, for the purpose of the following analysis, these conditions will be taken as the basis for all considerations. This is due to the fact, that even if the only advantage of bio-based plastic is the usage of non-finite resources, there are several possible developments which could increase the advantages of bio-based plastic in the future. One such development is the production of bio-based plastic from second-generation feedstock. Therefore, in view of the continuous advancement in this field, the objective of this master thesis is to identify the factors under which consumers decide to opt for bio-based plastic products over conventional plastic products.

2.3. Consumer Awareness and Perception of Bio-Based Plastic

Having discussed the advantages and disadvantages of bio-based plastic in the section before, it can be concluded that bio-based plastic materials need to be further developed in order to be a completely sustainable alternative to conventional plastic. In addition, in-depth LCAs need to be conducted according to credited standards in order to determine the actual environmental footprint of different bio-based plastic materials, as previously discussed. Moreover, the distribution of products made of biomass is only possible when the consumers are able to recognize the material as a suitable alternative for conventional plastic products. Currently, there is a limited number of products in the market that are bio-based. Therefore, consumers are not as aware that a material of this type exists. In addition, the characteristics of the materials, its usage potential, and the necessary disposal are unknown to the general public.

When asked about their awareness of bio-based plastic products in previous studies, consumers generally reported that they are familiar with them but have low knowledge of the material (Dilkes-Hoffman et al., 2019; Kainz, 2016; Scherer et al., 2017). Nevertheless, bio-based plastic

is perceived as positive, as being environmentally-friendly or sustainable (Blesin et al., 2017; Boz et al., 2020; Dilkes-Hoffman et al., 2019; Gaffey et al., 2021; Lynch et al., 2017; Sijtsema et al., 2016). Perception of bio-based plastic is ambivalent. This is due to the fact that, while there is a generally positive perception, there is a degree of uncertainty surrounding the terminology. In addition, consumers expressed concern about the trustworthiness of companies' claims, the perception that bioplastics are not environmentally-friendly and unsustainable, and that they are less convenient than conventional plastic (Dilkes-Hoffman et al., 2019; Kainz, 2016; Lynch et al., 2017). The uncertainness regarding the material also expresses itself in opposing opinions and expectations of the consumer. On one hand, the material is sometimes perceived as a high-quality product due to superior product characteristics while in contrast some deem bio-based plastic products as low quality due to a perceived weaker durability in comparison to conventional plastic (Findrik & Meixner, 2023).

When looking at the perception of consumers regarding bio-based plastics, Dilkes-Hoffman et al. (2019) found that most consumers relate bioplastics to end-of-life outcomes (biodegradable, recyclable, reusable) instead of the more fitting product characteristics of the material being made from plants and thus renewable resources. Moreover, the researchers demonstrated that consumers are likely to associate bioplastics with positive words and more favourable environmental outcomes. Another influencing factor on perception of bio-based plastic is whether consumers can overcome potential feelings of disgust coming from the acknowledgement that the product is made from organic waste, when the biomass is from secondary sources (Confente et al., 2020). It is only when the value of having such a source material is appreciated that it can be employed more thoroughly, thus enabling producers to increase production (Morone et al., 2021). A possible advantage for bio-based plastic in comparison to conventional plastic is that consumers who live in the Western hemisphere often have negative perceptions of plastic in general and try to reduce its consumption and as such

might be more favourable to using bioplastics in general and bio-based plastic products in particular (Kainz, 2016; Scherer et al., 2017). Herbes et al. (2018) found in their study that materials that are renewable were perceived positively by consumers, while materials that were both based on renewable sources and were biodegradable led to an even higher rating by consumers. This leads to the conclusion that biodegradability may lead to making the environmental benefits, which mostly lie at the start of the production cycle for renewable material, more salient for consumers (Taufik et al., 2020).

When looking at the usage of bio-based plastics, researchers have concluded that in their studies it has been apparent that consumers have had little contact with bio-based plastics. Current application fields of bioplastics are consumer goods and packaging, especially for food (Findrik & Meixner, 2023). Dilkes-Hoffman et al. (2019) report that most consumers are not sure whether they are using bio-based plastic products as the material is not distinguishable from conventional plastic. This confusion also impacts the disposal of products made of bio-based materials. Often, the material is disposed of in the wrong treatment stream leading to loss of material and more by-products of traditional waste management cycles (Findrik & Meixner, 2023).

Awareness and perception of bio-based plastic seems to differ by region. Significant differences in perceptions across different countries have been found which according to Herbes et al. (2018), Ruf et al. (2022), and Testa et al. (2021) is expected due to different cultural and institutional factors regarding environmental perceptions. For example, the impact of place of residence influences knowledge (Reinders et al., 2017), perception (Herbes et al., 2018), attitudes (Gaffey et al., 2021; Reinders et al., 2017), liking (Reinders et al., 2017), WTP (Gaffey et al., 2021), and purchase intention (Reinders et al., 2017), (Ruf et al., 2022). Dilkes-Hoffman et al. (2019) highlight that these differences in local attitudes need to be considered when developing bio-based product solutions. In addition, Paul et al. (2016) point out that high-

income countries usually are more concerned with the protection of the environment than low-income countries.

Lastly, environmental consumption is often characterised by the so-called intention-behaviour gap. The intention-behaviour gap describes the phenomenon that there is often significant difference between intention to purchase and actual purchasing behaviour between green and non-green consumers. It has been observed that green consumers often do not translate their intention to purchase green products into actual behaviour even though they are more willing to buy them, more so than non-green consumers (Barbarossa & De Pelsmacker, 2016). This may be attributed to a disparate temporal evaluation of perceived personal inconvenience, which affects the translating of intention to behaviour between green and non-green consumers. This temporally different negative variable might lead to a difference in the actual behaviour (Gupta & Ogden, 2009). It interacts with the green consumers' higher willingness to buy leading to decreased actual buying behaviour. In contrast, the non-green consumer is less willing to buy the green product and the perceived inconvenience of buying has little impact on their behaviour which in turn leads to the same buying behaviour (Barbarossa & De Pelsmacker, 2016). Additionally, according to Zwicker et al. (2023), environmental rewards for current purchasing decisions are psychologically distant, as the rewards lie in the distant future while the costs are immediate. As such the intentions in green purchasing behaviour are often not acted upon by green consumers.

The intention-behaviour gap has also been found for bio-based plastic products. The difference between consumer intention to buy bio-based products and the actual market share of them in the totality of plastic in the market leads to the assumption that there is also an intention-behaviour gap regarding bio-based plastic products (Ruf et al., 2022).

2.4. Perceived Knowledge of Bio-Based Plastic

As previously described, awareness and perception of bio-based plastic are important influencing factors on the acknowledgement of bio-based plastic products as a viable alternative to conventional fossil-based plastic products. It is only possible to evaluate a product if a person is aware of its existence. Tightly linked with the perception of bio-based plastic is the perceived knowledge that a person possesses about the specific product. There have been many studies investigating familiarity and knowledge of consumers regarding bioplastics, and their specific properties. The common finding and agreed upon conclusion among researchers is that consumer knowledge is rather low. Additionally, consumers are not familiar with existing bio-based plastic products. Moreover, they are confused about the terms surrounding the field and sometimes misinformed about product properties (Ruf et al., 2022). In general, consumers have both positive and negative attitudes and perceptions of bio-based products in regard to, for example, sustainability and environmental friendliness (Gaffey et al., 2021; Ruf et al., 2022). Zwicker et al. (2021) showed that consumers have more positive than negative evaluations of bio-based plastic products compared to conventional plastic. They also demonstrated that when participants gained knowledge about bio-based plastic and its characteristics, their attitudes are positive. In the following, the different knowledge categories regarding bio-based plastic are discussed more in detail, starting with the more general knowledge, leading to more specific knowledge regarding the term bio-based, the knowledge regarding disposal practices, the environmental impact, and lastly, the limited knowledge regarding certification systems for bio-based products.

First, bio-based material is not yet widespread and looks remarkably similar to conventional fossil-based plastic. As such, it causes confusion on whether consumers have already been in contact with it or not (Dilkes-Hoffman et al., 2019; Findrik & Meixner, 2023). In previous research, it has been shown that respondents are often unfamiliar with specific features of

bioplastics (Blesin et al., 2017; Dilkes-Hoffman et al., 2019; Herbes et al., 2018; Lynch et al., 2017; Sijtsema et al., 2016). In Blesin et al. (2017) study on perceptions on bioplastics in the German public, it was found that 57% of the German public had no knowledge about bioplastics, while only 7% thought they have knowledge and understanding of the product features of bioplastic. There is not only the limited or missing knowledge impacting consumers but also as Kainz (2016) has shown that the information consumers thought they possessed was misleading or wrong.

Second, the widely used term "bioplastic" seems to be causing confusion with consumers as it can be used for both bio-based and bio-degradable in the market. Rumm (2016) found that consumers in Germany connected "bio" to food, instead of renewable resources. This is the case as the term "bio" is used for organic food in Germany. That consumer associate food sources with the term bio-based has also been confirmed by Blesin et al. (2017). Moreover, Sijtsema et al. (2016) found in their study that the term "bio-based" is grouped with "bio-degradable" which is not always true as described in the section above. Bio-based material can be bio-degradable but the two terms "bio-based " and "bio-degradable" define two different characteristics of materials. Only a minority in this study knew that "bio-based" has nothing to do with fossil fuels but instead with renewable resources. Lynch et al. (2017) found in their focus groups in the Netherlands on innovations in the bio-based economy that there is scepticism to the term "bio" due to the possible negative impacts of bio-based material such as deforestation and food shortage. In addition, the participants of the study of Sijtsema et al. (2016) which was based on group discussions in the Czech Republic, Denmark, Germany, Italy, and the Netherlands associated bio-based primarily with positive environmental issues such as "naturalness" and "environmental friendly", but on the other hand also with negative environmental associations. This simultaneous presence of positive and negative associations leads to mixed feelings and uncertainty about products based on bio-material (Sijtsema et al.,

2016). When assessing previous research on whether consumers are able to distinguish the concepts of bio-based and bio-degradable most studies show that the terms are not distinguished at all. Blesin et al. (2017) found in their study in Germany that the respondents mostly thought that all bioplastics are completely plant-based and biodegradable. Similarly, Dilkes-Hoffman et al. (2019) found in their study based in Australia that most Australians were unsure on whether bioplastics are biodegradable with only 7.7% rejecting a statement saying that all bioplastics are biodegradable. In the same study they also found that only 5.5% of the Australian respondents referred to bioplastic as bio-based which shows the limited knowledge of product features. Moreover, the majority of the respondents within this study (58%) answered that they are unsure on whether biodegradable plastics can have negative environmental impacts (Dilkes-Hoffman et al., 2019). This confusion between the two terms bio-based and bio-degradability might be the reason that Rumm et al. (2013) found that consumers preferred the term "renewable resources" instead of "biobased" in their study.

Third, the necessary disposal practices are unfamiliar to consumers. Blesin et al. (2017) found in a study on the communicative challenges of bio-based plastics that respondents did not know that some types of bioplastics do not biodegrade outside of a composting facility. Similarly, Dilkes-Hoffman et al. (2019) show in their study on attitudes towards bioplastics in Australia that consumers do not know or understand end-of-life properties such as biodegradability or recyclability. This has also been shown in other studies regarding this matter. Many consumers assume that bioplastics are biodegradable (Zwicker et al., 2021), or throw them into the wrong bin when confronted with compostable bioplastics (Taufik et al., 2020). Taufik et al. (2020) also demonstrated that with increased bio-based familiarity, adequate consumer disposal increases. Specifically regarding bio-based packaging, Herbes et al. (2018) has described that consumers have a more favourable attitude towards the packaging if it is termed biodegradable or compostable for end-of-life treatment. The authors of this paper also found that consumers in

general are less concerned about the origin of the material and more with its end-of-life properties. Thanks to the cross-cultural nature of their study, Herbes et al. (2018) showed that German consumers are more concerned with the origin of the materials, as they identified renewable materials more often compared to other nationalities. The focus on the end-of-life properties has the effect of disadvantaging renewable source materials, whose environmentally-friendly effect is at the origin of the resources. This is because consumers focus on end-of-life properties, which has the consequence that the "eco-benefits of biobased materials remain largely intangible and mostly unrecognized" (Herbes et al., 2018, p. 214).

Fourth, the general environmental impact of bio-based plastic is unclear to consumers as shown in Ruf et al. (2022). Dilkes-Hoffman et al. (2019) found in their study that 58% of the respondents could not tell whether bioplastics have an environmental impact. Furthermore, Zwicker et al. (2021) demonstrated that consumers frequently overestimate the biodegradability of bio-based plastics and perceive recycling to be a less important task. It is noteworthy that the research does not provide clarity on the sustainability of the typical bio-based plastic materials. It would appear that only specific combinations of base material and production process are advantageous in terms of the environmental impact of conventional plastic (Rosenboom et al., 2022).

Fifth, to increase consumer knowledge, frequently used tools are common labels regarding specific product characteristics. Currently, there is no harmonised labelling system for bioplastic features in the EU which could help increase the consumer identification and knowledge of bioplastic products (EU Directorate-General for Environment; Findrik & Meixner, 2023). The topic of trust and labels is further discussed in section 3.2.1.4. Trust.

3. Literature Review & Hypotheses

3.1. Theory of Planned Behaviour (TPB)

3.1.1. Using the TPB for Bio-Based Plastic Product Intention

Consumers are the driving force of environmental protection and in encouraging companies in developing more environmentally-friendly solutions. Subsequently, it is important to improve the knowledge gathered about the factors that influence consumer consumption. This master thesis is determined at identifying and investigating factors that influence consumers' attitudes and intentions to use bio-based plastic as part of the change to more environmentally-friendly consumer behaviour. As the decision of using bio-based plastic over conventional plastic is a behaviour, this thesis is part of the research on human behaviour and its rationales and uses TPB as a framework. TPB is one of the most influential models to explain consumer behaviour based on intentions. It has been used extensively in the research on green consumer behaviour and purchase intentions to determine factors influencing consumer decisions in this field (e.g., Chen & Tung, 2014; Chen & Hung, 2016; Gutiérrez-Taño et al., 2022; Karim Ghani et al., 2013; Liu et al., 2020; Paul et al., 2016; Teng et al., 2015; Yadav & Pathak, 2016). The previous literature combining green consumer behaviour and TPB have shown the good fit of the theory for the topic. TPB has also been used previously in determining consumer intention for green products and specifically for bioplastic products (e.g., Gutiérrez-Taño et al., 2022) which is why TPB has been chosen as a framework to assess the factors influencing intention to use bio-based plastic products. In the next chapter, TPB and the extensions used in this master thesis will be explained in detail.

3.1.2. Development of the TPB

The Theory of Planned Behaviour (TPB) is a model put forward by Icek Ajzen in 1991 to explain human behaviour which is widely used in research and well supported by empirical

evidence (Ajzen, 1991). The base suggestion of TPB is that attitudes, taken together with subjective norms, and perceived behavioural control can predict intention to perform a specific behaviour with a high accuracy. The intention to perform a behaviour taken together with the influence of perceived behavioural control can then in turn predict a high variance in actual behaviour of an individual (Ajzen, 1991).

TPB is an extension of the Theory of Reasoned Action (TRA) which was first put forward by Fishbein and Ajzen (1975) and explains an individual's intention to perform a specific behaviour as determining actual behaviour (Fishbein & Ajzen, 1975, p. 16). TRA assumes that most social behaviour is volitional and as such a person should be able to execute any intention to behave into actual behaviour. The authors presume this is the case for most situations, except for unforeseen events (Fishbein & Ajzen, 1975, p. 15). Due to this, intention towards a behaviour is determined by the attitudinal beliefs a person has towards this specific behaviour and the normative beliefs they hold. Attitude is formed on the positive or negative evaluations the person has formed towards the specific object that the intention is in regard to (Fishbein & Ajzen, 1975, p. 14). The normative beliefs are formed based on what the specific person assumes that other people think on whether they should or should not execute a behaviour (Fishbein & Ajzen, 1975, p. 16). Attitude and subjective norm determine behavioural intention of an individual, and behavioural intention is considered the immediate antecedent of behaviour (Ajzen, 2002a). The specific concepts of this theory will be explained in more detail in the next sections.

As previously described, the TRA assumes that human behaviour is only determined by intention as behaviour is completely under volitional control. Within the social life this is not always the case. Most of the times, people lack complete volitional control over their behaviour and as such intention and behaviour is not only determined by attitude and subjective norm, but also by perceived behavioural control. To encompass these situations, Ajzen included a new

concept into the TRA, perceived behavioural control, and termed the new model Theory of Planned Behaviour (Ajzen, 1991).

Based on the expectancy-value model, TPB places beliefs at the basis of the model. They determine attitude, social norm, and perceived behavioural control, which in turn determine behavioural intention and in the end behaviour (Fishbein & Ajzen, 1975). TPB encompassed three kinds of considerations that guide human behaviour; "beliefs about the likely consequences or other attributes of the behavior (behavioral beliefs), beliefs about the normative expectations of other people (normative beliefs), and beliefs about the presence of factors that may further or hinder performance of the behavior (control beliefs)" (Ajzen, 2002a, p. 666). Each of the individual belief categories form their individual constructs. Behavioural beliefs form a positive or negative attitude towards the behaviour, normative beliefs lead to perceived social pressure or subjective norm, and control beliefs aggregate to perceived behavioural control, which is "the perceived ease or difficulty of performing the behavior" (Ajzen, 2002a). Taken together, the three concepts - attitude towards the behaviour, subjective norm, and perceived behavioural control - lead to the establishment of a behavioural intention. When a person then possesses enough volitional control, it is assumed that they carry out their intended behaviour, when they get the opportunity to do so (Ajzen, 2002a). The connections between the different concepts included within the TPB, the three distinct types of beliefs, the immediate antecedents of intention – attitude, subjective norm, and perceived behavioural control, intention itself and lastly, behaviour can be seen in figure 4 below.

Figure 4: Theory of Planned Behaviour based on beliefs
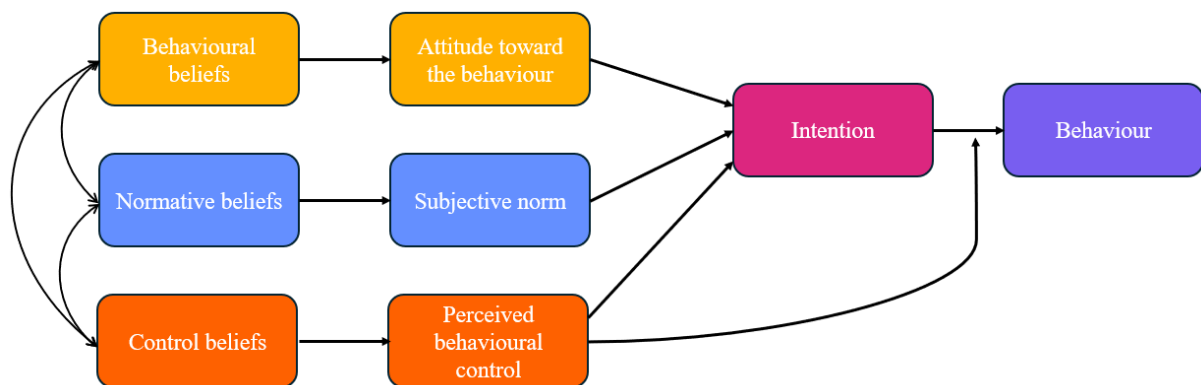
Source: Own illustration based on Ajzen (2005, p. 126)

In the following sections, the main constructs of the TPB will be discussed in detail, starting with attitude.

3.1.3. Attitude

According to the TPB, attitude is the main determinant of intention towards a specific behaviour. It is defined as the positive or negative evaluation or appraisal of behaviour (Ajzen, 2002a).

As mentioned in the section above, attitudes towards a behaviour are assumed to develop from beliefs that people hold about performing the behaviour. The beliefs are developed from attributes, e.g. with other objects, characteristics, or events, and can be formed by direct observations, by information received from outside sources, or by inference processes. Following this process, beliefs are formed about a person themselves, about other people, behaviours, and more (Fishbein & Ajzen, 1975, p. 14).

According to Fishbein and Ajzen (1975, p. 218) the underlying beliefs determining attitude towards a behaviour or object are not stable over time, they may change, be forgotten, or some new beliefs may be added to the set of beliefs. Moreover, some beliefs may change more frequently than others that are more stable. As such, a person's attitude based on the specific set of beliefs may also change.

While a person holds a substantial number of total beliefs regarding a specific behaviour, not every belief is used to form an attitude. According to Fishbein and Ajzen (1975, p. 218) there exists a small number of so-called salient beliefs which are the ones used to primarily determine the attitude towards an object or behaviour, and which are salient at any point in time. Salient beliefs are defined as "the prevailing determinants of a person's intentions and actions" (Ajzen, 1991, p. 189). These salient beliefs are also able to change; they may weaken, be strengthened or replaced by new salient beliefs (Fishbein & Ajzen, 1975, p. 218).

TPB also explains how a positive or negative connotation to an attribute and belief is transported and attached to the valuation of a behaviour. The process of this will be explained in the following. The attributes that form the beliefs are automatically associated with positive or negative evaluations which in turn leads to the attitude to be positive or negative. As attitude is the main determinant of behaviour this leads to the behaviour being loaded with these positive or negative evaluations (Ajzen, 1991; Fishbein & Ajzen, 1975, pp. 14, 335). The attitudinal beliefs (beliefs that are negative or positive and linked to a specific behaviour) automatically link the positive or negative attributes to the specific outcome connected to the behaviour in question. Due to this automatic connection building, people tend to favour actions they think will primarily result in positive outcomes and disfavour actions they think will primarily result in negative outcomes (Ajzen, 1991). In general, most people can simultaneously have positive and negative beliefs about an object, and as such, the attitude towards a specific behaviour or object is determined by the total aggregate of the beliefs, both positive and negative towards the behaviour or object (Fishbein & Ajzen, 1975). Moreover, Fishbein and Ajzen (1975, p. 14) also suggest that attitude is not related to one specific belief but to a set of beliefs about the object or behaviour.

A similar aggregation happens when looking at the relation between attitude and intention to perform a behaviour. An individual's attitude toward an object is thought to be connected to

their intentions to engage in a range of behaviours regarding that object. This relationship exists between the attitude and the collection of intentions as a whole; typically, attitude toward an object is unrelated to any particular intention regarding the object. Following the argumentation above, the overall pattern of a person's actions, which is based on the collection of intents, thus expresses their attitude toward the object (Fishbein & Ajzen, 1975, p. 15).

3.1.4. Subjective Norms

The second construct which is important for the formation of intention is subjective norm. Ajzen (2005, p. 137) describes subjective norm as being determined by the set of beliefs of normative nature of two diverse kinds. The first set is whether a person believes that other people, groups, or individuals, approve or disapprove of them performing a specific behaviour which is called injunctive normative beliefs. The second set is called descriptive normative beliefs and they describe whether the referent engages or does not engage in the specific behaviour in question. The referents for these beliefs can be individuals or groups depending on the context and may include the person's spouse, close family, close friends, coworkers, and sometimes experts on a specific topic, such as health care professionals (Ajzen, 2005, p. 137).

In addition, the motivation of whether the person thinks they should comply with the referent or not is important. Both normative beliefs and the motivation to comply aggregated lead to normative pressures, where the sum of all normative pressures is called "subjective norm" (Ajzen, 1991; Fishbein & Ajzen, 1975). If an individual believes that more important referents want them to behave in a certain way and they are motivated to comply, the higher the perceived social pressure and as such the intention (Ajzen, 2005, p. 137). In other words, subjective norm expresses the person's opinion on whether other people, which are important to them, want them to perform or not perform a specific behaviour. The reference group or individual that is evaluated within the subjective norm construct depends on the context, they can be, for example, family, work peers, or society at large. There can also be more than one reference

group that influence the perception of subjective norm and the motivation to comply (Fishbein & Ajzen, 1975, p. 302). Furthermore, the motivation to comply may change not only depending on the relative importance of the referent but also their social power. Fishbein and Ajzen (1975) argue that a person may be more inclined to comply when the referent has more social power over them, if they are able to reward or punish, and whether their power over the person is legitimate.

3.1.5. Perceived Behavioural Control

Perceived behavioural control is the third major predicting factor of intention, alongside attitude and subjective norm, with their respective behavioural beliefs and normative beliefs. It was added in form of the development of the TPB from the TRA as a way of representing situations, in which an individual does not have complete control over the behaviour in question, or as Ajzen terms it, limited volitional control (Ajzen, 2002a, p. 666).

Perceived behavioural control is also assumed to be a function of beliefs, in this case control beliefs. They are defined as "beliefs about the presence or absence of factors that facilitate or impede performance of the behaviour" (Ajzen, 2005, p. 125). Put together, these control beliefs in their totality "lead to the perception that one has or does not have the capacity to carry out the behavior, i.e. behavioral control" (Ajzen, 2005, p. 125). In other words, perceived behavioural control indicates the extent to which people expect to be able to perform a behaviour. This might concern possessing the right resources or overcoming obstacles. Moreover, the resources or obstacles can be both internal and external (Ajzen, 2002a, p. 666). Put differently, perceived behavioural control depends on the existence of a variety of internal and external factors that may help or hinder the execution of the behaviour (Ajzen, 2002a, p. 678).

In TPB, it is assumed that the only necessary conditions that must be met for obstacles and resources to be influential, are the extent to which they are believed to be present and whether the individuals feels as though they impede or facilitate the behaviour in question (Ajzen, 2002a, pp. 666-667). As such, not actual control is used but the perception of the existing controls and its impact on an individuals' intentions and behaviours (Ajzen, 1991, p. 183).

According to Ajzen (2005, p. 125), the control beliefs regarding perceived behavioural control can develop from past experience with the same or similar behaviour. Moreover, they can be developed according to second-hand information about the behaviour, observed experiences from family and friends, and other influencing factors.

In general, the following relation is assumed. The more resources required and the more the behaviour is impeded by perceived difficulty or obstacles, the lower the perceived behavioural control. On the other hand, the more resources and opportunities an individual possesses and the lower the anticipated obstacles, the greater the perceived behavioural control (Ajzen, 2005, p. 125).

Influences of Perceived Behavioural Control

According to TPB, perceived behavioural control, in combination with behavioural intention can be used directly to predict behaviour. As described above, behavioural intention is determined by attitude, subjective norm, and perceived behavioural control. According to Ajzen (1991), this can be attributed to two different explanations. First, given that intention is held constant, with increased perceived control, the effort and perseverance employed by the individual to conclude a behaviour is expected to increase (Ajzen, 2002a, p. 667). The example given by Ajzen (1991) is concerning two people learning to ski, which have equally strong intentions to learn this sport. According to the rationales of TPB, the person that is confident that they are able to learn the sport is more likely to succeed, instead of the person that doubts

their ability to succeed. Due to this, perceived behavioural control has a motivational component. On the other hand, even individuals that hold positive attitudes towards the behaviour and feel that important people in their life approve of their behaviour will not exhibit strong intentions if they lack the resources and opportunities needed for the behaviour, meaning they lack perceived behavioural control. This relationship exists without the mediation of attitude or subjective norm (Ajzen, 2005, p. 119).

The second influence of perceived behavioural control on behaviour according to Ajzen (1991) is that there is a direct link between perceived behavioural control and behaviour. Sometimes, the execution of a behaviour is not only dependent on the motivation to perform a specific behaviour, but also on whether the individual has enough control to do so. In the case that perceived behavioural control is close to actual control, goal attainment is independent from behavioural intention (Ajzen, 2005, p. 119). With limited perceived behavioural control, for example, when new or unfamiliar information appear, when the requirements or available resources change, or there is limited information about the behaviour, the inclusion of perceived behavioural control does not explain actual behaviour well. Nonetheless, perceived control can be used to forecast the likelihood of a successful behavioural attempt to the extent that the perceived control is realistic and is frequently used as a stand-in for a measure of actual control (Ajzen, 1991). To conclude, perceived behavioural control has two different influences, one direct one, via intentions, and one indirect one, when considered as a proxy for a measure of actual control (Ajzen, 2005, p. 119).

3.1.6. Intention

According to the TRA and TPB intentions are the immediate antecedent of wilful behaviour. Ajzen (1991) defines: "Intentions are assumed to capture the motivational factors that influence a behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior" (Ajzen, 1991, p. 181). Generally,

the performance of a behaviour is more likely, the stronger the intention; but only if the behaviour is under volitional control (Ajzen, 1991). In other words, intention to perform a behaviour is a person's most immediate determinant of that behaviour (Ajzen, 2005, p. 117).

According to Ajzen, intention is also a function of beliefs concerning the behaviour itself, instead of being about the object of the behaviour (Fishbein & Ajzen, 1975, p. 27). TPB includes three different determinants of intention, which have been described above, attitude, subjective norm, and perceived behavioural control. First, attitude towards a specific behaviour refers to the favourable or unfavourable evaluation or appraisal of the specific behaviour. Second, subjective norms can be explained as the social pressure experienced by an individual to perform or not perform a behaviour. Third, perceived behavioural control which refers to the perceived ease or difficulty of performing a behaviour (Ajzen, 1991). According to Ajzen (1991) "the more favorable the attitude and subjective norm with respect to a behavior, and the greater the perceived behavioral control, the stronger should be an individual's intention to perform the behavior under consideration" (p. 188). The amount of influence each of these antecedents to intention has is dependent on the respective behaviour and situation. It might be the case that only one or two of the antecedents impact intention. At the same time, it could also be the case that all three antecedents are needed to explain variance in intention (Ajzen, 1991).

In most situations, there is at least some degree of nonmotivational factors that limit volition, such as limited resources or opportunities and as such decreases intention and in turn actual behaviour (e.g. time, money, skills, cooperations of others) (Ajzen, 1991). Consequently, even if there is the intention to perform a specific behaviour, a large number of behaviours present difficulties in performing them due to the previously mentioned factors limiting volitional control. Due to this, Ajzen (2002a, pp. 665-666) recommends looking at perceived behavioural control in addition to the motivational factors of intention in order to arrive at a more accurate

prediction of behaviour. The closer an individual's perception of control is to actually experienced control, the more accurate the prediction of behaviour becomes (Ajzen, 2002a).

Taking into account all of the above described details, intention is a concept rather close to actual behaviour. Within research based on the TPB, actual behaviour is the less often studied concept in comparison to intention as it requires an experimental set-up in order to receive reliable results. As intention is the most important predictor for actual behaviour, intention will be studied in the context of this master thesis, instead of actual behaviour (Ajzen, 2005, p. 117).

3.1.7. Previous Research on Green Consumerism Using TPB & Hypotheses

After defining the TPB in the previous sections, this section looks at previous research done within the pro-environmental behaviour and green consumerism field. In addition, some hypotheses are developed.

The TPB is a theoretical model that is used extensively in the research area of green consumerism and pro-environmental behaviour to predict the decisions and behaviours regarding environmental issues or the adoption of specific products. With TPB, a person's attitude and intention toward sustainable products or sustainable actions can be predicted and explained. The theory is applicable in specific behavioural situations, for example regarding specific prices or availabilities, and can predict particular observable behaviours (Boz et al., 2020).

Most of the more recent studies using TPB to predict sustainable behaviour have extended the original TPB to increase predictive validity of the model. Some of the included variables are environmental concern (Moslehpour et al., 2023; Sun et al., 2017; Teng et al., 2015; Yadav & Pathak, 2016), environmental knowledge (Moslehpour et al., 2023; Sun et al., 2017), green consumer values (Gutiérrez-Taño et al., 2022; Klein et al., 2019), altruism (Chen & Tung, 2014), and situational factors (Heidari et al., 2018; Karim Ghani et al., 2013), among others.

Attitude is one of the most investigated variables and was found to be a significant predictor in several studies regarding environmental behaviour, such as waste separation (Heidari et al., 2018; Karim Ghani et al., 2013), usage of plastic bags (Sun et al., 2017), and green hotel visits (Chen & Tung, 2014; Teng et al., 2015).

More specifically to consumption of environmentally-friendly products, Paul et al. (2016) found for consumers in India that consumer attitude significantly predicts purchase intention of green products and was the strongest predictor among the model. When predicting the behavioural intention of visiting a green hotel in Taiwan, Teng et al. (2015) and, similarly Chen and Tung (2014), found that attitude was one of the concepts that positively influenced intention. Regarding the installation of eco-friendly home-appliances, Asif et al. (2023) found that attitude moderated the relationship between environmental knowledge and green behaviour, and additionally, that attitudes are an important influence on behaviour.

Chen and Hung (2016) concluded from their study on determinants of acceptance of green products that attitude is a significantly positive indicator of intention which is the same result that Yadav and Pathak (2016) found in their study regarding young Indian consumers' intention to buy green products. Attitude was found to be the most significant predictor on behaviour intention in a study by Liu et al. (2020) who investigated the intention to buy green products in China. In a study regarding green products in Taiwan, Moslehpour et al. (2023) found that consumer attitude plays a mediating role between several concepts such as eco-innovation, environmental concerns, environmental knowledge, and intention to purchase green cosmetics.

When examining the significance of attitude regarding specifically bio-based material, Rumm (2016) found in her study on bio-based plastic that the attitude towards the material significantly increased intention to purchase. In a more recent study regarding bio-based plastic, Gutiérrez-Taño et al. (2022) also found that attitude has a significant positive influence on intention to use bio-based plastics. The concept attitude in their model was extended by the

variables "environmental issues", "interest in information about bioplastics", and "green consumer values" which all resulted in increased explanation of attitude.

Taking all of the previously discovered findings into account, in addition to Klein et al. (2019) documenting that attitude toward bioplastics significantly influences German consumer's intention to use bioplastics, the following hypothesis is proposed:

H1. A positive Attitude toward bio-based plastic products positively influences Intention to use bio-based plastic products.

Subjective norm is also well-studied in the literature regarding pro-environmental behaviour and green consumption. Heidari et al. (2018) found that subjective norm has a positive impact on the intention and actual performance of source separation of waste among students in Iran. Subjective norm was also found to be one of the influencing factors that positively impacted intention of visiting a green hotel in Taiwan (Chen & Tung, 2014; Teng et al., 2015). Furthermore, in regard to usage of plastic bags, Sun et al. (2017) found that subjective norm has a significantly positive relation on the intention to reduce usage of plastic bags.

Examining young consumers' intentions to buy green products in India, Yadav and Pathak (2016) found that subjective norm has a positive impact on the intention to buy green products. A similar result could be found by Liu et al. (2020) in a study based in China regarding the influence of subjective norm. They further investigated this relationship by including the concept of moral norm which had an even larger effect on intention than subjective norm as moral norm is an important concept within China (Liu et al., 2020).

More recently, Gutiérrez-Taño et al. (2022) found in their study on intention to use bio-based plastic that subjective norm influences intention positively directly. In addition, they found that subjective norm indirectly influences intention through attitudes and their approximation of perceived behavioural control, activity to reduce plastic.

In the realm of bioplastic, Klein et al. (2019) confirmed in a study on the influencing factors for the purchasing intentions of German consumers that subjective norm positively influences the intention to use bioplastics. Resulting from the previous research, the following hypothesis is put forward:

H2. High social pressure (Subjective norm) positively influences Intention to use bio-based plastic products.

Perceived behavioural control is also studied extensively in the literature. For separating waste in Malaysia, Karim Ghani et al. (2013) found a small but significant influence of perceived behavioural control on intention to separate waste. A larger influence of perceived behavioural control was found in a study in Iran also regarding waste separation behaviour (Heidari et al., 2018). In regard to visiting a green hotel, both Teng et al. (2015) and Chen and Tung (2014) found that perceived behavioural control positively influences intention among Taiwanese consumers. Moreover, when looking at the usage of plastic bags, Sun et al. (2017) found that perceived behavioural control significantly affects consumers' intention to use plastic bags.

More specifically for green products, in their paper on intentions of Indian and Taiwanese consumers to buy eco-friendly products, Paul et al. (2016) and Chen and Hung (2016) found that perceived behavioural control significantly predicts purchase intention of green products. This result was also found in a more recent study of Asif et al. (2023) where they investigated the determinants of consumers' intentions to buy eco-friendly household appliances. Similarly, Yadav and Pathak (2016) found a positive influence of perceived behavioural control on intention to buy green products when investigating young Indian consumers.

In the following the more specific field of bio-based plastic and findings regarding this field are discussed. In a recent study of Gutiérrez-Taño et al. (2022) perceived behavioural control was approximated by activity to reduce plastic use. The researchers argue that individuals carry out

behaviour that is reflecting past experience and ability to behave in a certain way. Due to this, if the individuals perform activities to reduce plastic usage, they should have high perceived control which in turn has a considerable influence on their use of bioplastics. The results show that activity to reduce plastic use has a significant impact on intention to use bioplastics which proves the hypothesis that activity to reduce plastic is an appropriate measure to reflect perceived behavioural control (Gutiérrez-Taño et al., 2022).

In this master thesis, perceived behavioural control will be approximated by two other constructs, perceived cost, and perceived behavioural control, both of which will be discussed more in detail in section 2.3.2. Operationalising Perceived Behavioural Control in addition to the proposed hypotheses.

Lastly, the TPB also describes an indirect relationship between subjective norms and intention via respectively attitude and perceived behavioural control (Ajzen, 1991). This has been demonstrated by Paul et al. (2016) in the sphere of eco-friendly products in India. In their study focusing on the intention to buy eco-friendly products they found that subjective norm is a significant predictor of attitude and perceived behavioural control. The same result was also found by Gutiérrez-Taño et al. (2022) regarding the intention to use bioplastics demonstrating the significant influence of subjective norm, directly and indirectly, on intention.

3.2. Extending the Theory of Planned Behaviour

The TPB is a model that is generally used in the field of behavioural studies and not tied to a specific subject area. According to Ajzen (1991), "TPB is, in principle, open to the addition of further predictors under the condition of them explaining a significant amount of the variance on intention or actual behaviour, after the current variables have been evaluated in their effect." Following this suggestion, several constructs have been used and evaluated on their fit within the TPB framework in recent years (Yadav & Pathak, 2016). Based on this, the literature in the

green products and specifically bio-plastic area has been researched on the determinants of using a more environmentally-friendly or bio-based product. In the following, the concepts that are discussed in the literature and which are used in this master thesis to attempt to extend the TPB are explained.

First, within this master thesis the attitude toward and intention to use bio-based plastic products is investigated. Following the literature review, several different concepts are used in order to extend the TPB in the field of bio-based plastic products. The concepts which were chosen from the literature review and discussed within the following sections are: Green consumer values, Perceived consumer effectiveness, Habit, and Trust. Second, the factors that approximate perceived behavioural control in this master thesis, Perceived costs, and Perceived convenience, are discussed. Third, the influence found in the literature of socio-demographic factors and Previous product experience on intention to use bio-based plastic products or green products in general is described.

As bio-based plastic is not yet widely distributed, there is not a large number of studies on consumer behaviour regarding these materials. Due to this, consumer behaviour towards bio-based plastic products will be explained and approximated in the following with consumer behaviour regarding other environmentally-friendly products, wherever necessary.

3.2.1. Influencing Factors on Attitude and Intention

In the following, based on the literature, four concepts are discussed that are expected to influence attitude toward and intention to use bio-based plastic products and as such are used on this master thesis to extend the TPB. In addition, the corresponding hypotheses are proposed.

3.2.1.1. Green Consumer Values

Green consumer values are among the most examined factors in the field of pro-environmental consumption. They include green environment-related factors such as altruism, green product

features, green self-identity, perceived sustainability, environmental norm, environmental awareness, nature relatedness, and environmental concern (Findrik & Meixner, 2023). Green consumer values are formally defined by Haws et al. as "the tendency to express the value of environmental protection through one's purchases and consumption behaviors" (Haws et al., 2014, p. 337). They argue that there are individual differences between consumers in the value they place in protecting resources at the environmental and personal level which is reflected in their decisions regarding consumption behaviour. The researchers have introduced the GREEN scale with which consumer preferences for environmentally-friendly products can be shown. They argue that the stronger the green consumption values are, the larger the preference for green products through a more favourable evaluation of the products' non-environmental attributes (Haws et al., 2014). According to Findrik and Meixner (2023), there are several studies investigating the impact of green identity on attitude under several different more specific definitions, all of which found that green values influence purchase intention and that the higher the green values, the higher the purchase intention of bioplastic (Herbes et al., 2018; Scarpi et al., 2021; Scherer et al., 2017, 2018b). Most literature findings agree that environmental attitudes, in whichever definition, have an impact on the decision-making of consumers (Ruf et al., 2022).

A similar construct often researched in the sphere of green products is green self-identity, where Trudel (2019) describes that consumers "choose sustainable actions because these are consistent with and allow them to express their environmental beliefs" and as such are consistent with their self-identity (Trudel, 2019, p. 88). Confente et al. (2020) found in their study that green self-identity positively impacts perceived value which in turn leads to higher behavioural intention. This is especially the case if the consumer feels a high congruence between themselves and the product, e.g. for being environmentally-friendly, the consumer perceived the product as being of higher value, and as such it leads to higher purchase and

switching intentions. Moreover, they conclude from their results that if a product's value and potential positive effect of the environmental is made clear, the consumer would be more willing to accept a bioplastic product. Additionally, the fit of the consumers' green personal values with the products' features needs to be demonstrated for the product to be more likely chosen (Confente et al., 2020). In an earlier study Barbarossa and De Pelsmacker (2016) found that green self-identity impacts the acceptance of green products and that green self-identity plays a mediating role between product involvement and intention to purchase bio-based products. These findings confirm the importance of green self-identity in consumer decisions regarding bio-based products. In another study, Scarpi et al. (2021) demonstrated that green identity leads to a high intention to switch to bioplastic products. Similarly, Russo et al. (2019) found the influence of green self-identity as a predictor of the intention to purchase, pay for, and switch to bio-based products.

Concerning bio-based material, Niedermeier et al. (2021) found in a study concerning fast moving consumer goods in Germany that green consumer values are a driver for purchasing green products.

Regarding specifically bio-based products, Rumm (2016) demonstrated in her influential PhD-Thesis that people with higher environmental consciousness have a more positive mindset towards bio-based plastic, and are more willing to pay attention in the future to buy bio-based products. In addition, people who have higher environmental norms are more sensitive toward the percentage of used bio-based material in a product (Reinders et al., 2017). Scherer et al. (2017) and Scherer et al. (2018b) showed in two studies regarding bio-based functional clothes that consumers with higher environmental attitudes and higher green consumer values are more likely to choose bio-based products. They conclude that higher green values lead to a higher preference for green functional clothes. Moreover, they demonstrated that the consumers that are more environmentally aware and sensitive to the origin of the raw material, are more

interested in ecologically valuable product attributes or renewable origin products, such as plastic made from biomass (Scherer et al., 2017). In a later study, this has also been confirmed by Zwicker et al. (2023) who showed that the more participants identified as environmentalists, so in other words, have green values, the more likely they were to choose a paper PEF bottle instead of a PET bottle, and the more they were willing to pay for bio-based bottles.

The previous research demonstrates that green consumer values are important and have a significant influence on the perception and attitude of a consumer regarding bio-based plastic products. In addition, it shows that green consumer values are important indicators for the purchase decision. Based on the argument of TPB, intention toward a behaviour is the immediate antecedent of actual behaviour. Due to this it can be assumed that in order to purchase something, the intention to use the product, i.e. use a bio-based plastic product, is developed. Based on these findings, the following hypotheses are proposed:

H3a. Green consumer values positively influence Attitude toward bio-based plastic products.

H3b. Green consumer values positively influence Intention to use bio-based plastic products.

3.2.1.2. Perceived Consumer Effectiveness

The second construct that will be added as an antecedent to attitude and influence on intention in this study is perceived consumer effectiveness. This construct defines the belief that individuals are able to influence environmental issues (Scherer et al., 2018b) as it is not only important that people care about the environment but also that they feel like their actions will leave a positive impact (Niedermeier et al., 2021; Roberts, 1996). In contrast, it has been described that "the more the individual beliefs that it is too difficult to do much about the environment, the less he or she is willing to offer to protect the environment (the less pro-environmental the attitude)" (Thøgersen, 2000, p. 300). Consumers who believe they can improve environmental deterioration are more likely to perform ecologically conscious

consumer behaviours while consumers that do not believe they can decrease the environmental resource problems are not as willing to perform environmentally-friendly behaviour (Roberts, 1996). Roberts (1996) deemed perceived consumer effectiveness as one of the principal factors determining behaviour regarding green products.

In an early study regarding the consumption of sustainable dairy, Vermeir and Verbeke (2006) showed that perceived consumer effectiveness has a positive impact on attitude toward buying the sustainable dairy, which in turn has a strong influence on intention to buy.

Gaffey et al. (2021) demonstrated in their quantitative study on the perception of bio-based products in Ireland and the Netherlands that most of the consumers believe that their choices can have a positive impact on the environment, 92% believing so in Ireland and 89% doing so in the Netherlands. With a sample size of 500 for each country the findings are representative of each of the population groups. In addition, the researchers found that most respondents in their study would prefer to buy a bio-based alternative compared to a conventional product (Gaffey et al., 2021).

Niedermeier et al. (2021) demonstrated in their study, that perceived consumer effectiveness is an important characteristic for consumers who chose the green product, in this case a green glue stick. In addition, in the more recent study of Asif et al. (2023) on the purchase intention of green household appliances, the researchers concluded that perceived consumer effectiveness has a positive and significant influence on purchase intention. As TPB assumes that attitude is a direct and the most important influence on intention, it can be assumed that the impact of perceived consumer effectiveness is also positive on attitude. Jaiswal and Kant (2018) showed in their study on cognitive factors influencing green purchase intentions that perceived consumer effectiveness was directly and indirectly, via attitude towards green products, significant in influencing green purchase intention.

Specifically regarding bio-based plastic products, Scherer et al. (2017) found that environmental-conscious consumers have a significant perceived consumer effectiveness and are more interested in buying bio-based alternatives in the future.

It can be concluded from the research that perceived consumer effectiveness has a general positive influence on the green consumption behaviour of consumers. Specifically, it has been shown that a high perceived consumer effectiveness has a positive influence on green purchase intention and that a higher perceived consumer effectiveness also has a positive influence on attitude towards green products. Due to this, the following hypotheses are proposed:

H4a. Perceived Consumer Effectiveness positively influences Attitude toward bio-based plastic products.

H4b. Perceived Consumer Effectiveness positively influences Intention to use bio-based plastic products.

3.2.1.3. Habit

In addition to the environmental outlook of consumers with Green consumer values and Perceived consumer effectiveness, Habit is added into the model. It is one of the factors expected to negatively influence purchasing behaviour. There has been a limited number of studies testing the relationship of habit and green purchasing behaviour. Nevertheless, according to Testa et al. (2021), consumer behaviours can be strongly impacted by habit and routine. One influence on habit is the loyalty towards brands. If consumers are strongly committed to brands, they are less likely to change their product choice by looking for other brands (Kumar Mishra et al., 2016). Nguyen et al. (2016) authored a research paper on the product category energy-efficient household appliances which investigates the effect of consumers' biospheric values on their purchase behaviour. Their results lead to the conclusion that it is important that there is an easily accessible retail shopping environment for consumers,

especially for first-time buyers as they need to actively switch towards the more environmentally-friendly option. Niedermeier et al. (2021) argue and demonstrate in their study on purchasing of bio-based products that due to brand loyalty consumers often are either unwilling to choose a green product instead of the habitual conventional product or do not know that they exist. This is especially the case if appropriate information is limited.

Aggregating these finding leads to the conclusion that habit serves as a barrier to trying new brands. Due to the barrier of habit, products in the sphere of bio-based plastic are viewed with a lower attitude as they are not perceived as useful alternatives to known brands or products. One explanation of this is that consumers do not know these products exist or are committed to the products they always buy. As bio-based plastic products are not yet widely distributed one can expect that these products are seen as the new products that might serve to replace conventional plastic. Consumers that are characterised by habitual buying decisions thus have less intention to use bio-based plastic products instead of conventional plastic products. Based on this argumentation, the following hypotheses are proposed:

H5a. Habit negatively influences Attitude toward bio-based plastic products.

H5b. Habit negatively influences Intention to use bio-based plastic products.

3.2.1.4. Trust

Trust can be defined as an indicator of an individual's ability to trust other persons' actions (Beierlein et al., 2012; Klein et al., 2020). According to Brach et al. (2018), trust is an important concept in the field of sustainable products, as sustainable products are characterised by credence qualities and increased perceptions of risk. For example, producers' sustainability claims cannot be easily proven by the individual consumer resulting in decreased purchasing intention for sustainable products (Brach et al., 2018). The information asymmetry in the market

can be alleviated by third-party certification labels (TPCL), which independently confirm the claims of the company (Thøgersen et al., 2010).

In the green products field, TPCL are often called eco-labels and are defined as "information of claims provided with a product that tell consumers about the quality, features or production methods that reduce environmental impact, aiming to facilitate decision-making (Thøgersen et al., 2010, p. 1787). In addition, eco-labels reduce barriers to green purchasing due to increased provision of information and their credibility and as such support decision-making (Brach et al., 2018; Thøgersen et al., 2010). As Niedermeier et al. (2021) argue, consumers are often in doubt whether the producer's claims on the sustainability of the product are true. Due to this, they have no intention to pay more for a product if they are not sure on whether it is more sustainable.

Several studies have confirmed that additional information on the correctness of sustainability claims is useful for the consumer (Moon et al., 2017; Morone et al., 2021). In contrast, there are several conditions that limit the effectiveness of eco-labels such as limited consumer knowledge of certification and lack of awareness of certification options (Brécard, 2014; Moon et al., 2017; Morone et al., 2021). Additionally, an overwhelming amount of labels in specific product categories can again confuse the consumer as they do not know which one is the best to choose and then often choose according to design (Brécard, 2014). Furthermore, Thøgersen (2000) argues that consumers paying attention to eco-labels depends on several factors. These factors include the belief in the personal effectiveness in protecting the environment, the importance of protecting the environment as seen by the consumer, and by trust in the labels which is dependent on countries and regions. Another factor to consider with eco-labels is that to be the most effective they should be simple and easy to understand to alleviate the time and effort consumers have to spend evaluating products (Herbes, 2021).

When looking at research specifically on eco-labels concerning bio-based plastic, trust was found to be an important characteristic for consumers preferring bio-based products (Niedermeier et al., 2021). Trust in claims on eco-labels according to research of Klein et al. (2020) on bio-based apparel can be perceived as trust in the agent's products in general. Scherer et al. (2017) argue that labelling or certification schemes for bio-based plastic products can aid consumer purchasing decisions and to retain trust. In their study on children's sand toys made from bio-based materials, they caution for the introduction of a new label regarding bio-based products that a long time period and substantial financial resources are necessary in order to actively promote the familiarity of consumers with a label and the use of it to evaluate products. In addition, a label should introduce mandatory and uniform requirements concerning environmental and health standards of bio-based plastics, and be controlled by an independent institution (Scherer et al., 2017).

In another study by Rumm (2016) looking at the use of a label for bioplastics it was found that the reaction to the presence of a label was ambivalent. One half of respondents expressed trust in labels for bio-based plastic and thought that such a label would help them in the buying process. Contrarily to this finding, the researcher found that labels did not play a role in influencing the decision-making process. An explanation for this could be that the labels used in the study might confuse the participants as they come from unknown organisations and the conditions for the labels are unclear (Rumm, 2016).

Lastly, another issue concerning labels and trust is that the evaluation of different percentages of ingredients of bio-based materials expressed on the label seemed to make a difference. Sijtsema et al. (2016) went into depth in an exploratory study on the perceptions of bio-based products and found that there is a difference in the perception of fully vs. partially bio-based. They found for a bottle made of a relatively low content of bio-based materials that participants were wondering about the motives of the company. Some of the consumers were considering

the bottle as being used for greenwashing or for profit as only a comparatively low amount of bio-based material was included. The researchers found that consumers have a more positive impression of bio-based products which are fully bio-based instead of only partially bio-based. More in detail, they found that for partially bio-based products the associations were more often negative terms such as environmentally-unfriendly or toxic, distrust, and marketing tricks of large companies. When the percentage of bio-based material was particularly small, the researchers found that participants believed that the inclusion of bio-based material was externally motivated such as a way to increase profits. They concluded from their findings that the percentage of bio-based material could also be too small (Sijtsema et al., 2016).

With these findings from the previous research on labels and trust in labels it can be concluded that trust is an important concept influencing attitude toward bio-based plastic products. The higher the trust in the environmental friendliness of the product, the label, or the company, the more positive the attitude towards it. Bio-based plastics are beneficial for the environment as they reduce the amount of petroleum-based resources needed and could increase the usage of renewable sources. When trust in the environmental friendliness of bio-based plastic products is increased, for example through an independently controlled eco-label, attitude towards them should turn to be more positive. In addition, a label, when it is trusted, validates the claims a company made about the sustainability of the products. Such a trusted claim should in turn increase the intention of the consumer to buy such a product. As such the following hypotheses are proposed:

H6a. Trust positively influences Attitude toward bio-based plastic products.

H6b. Trust positively influences Intention to use bio-based plastic products.

3.2.2. Operationalising Perceived Behavioural Control

Perceived behavioural control in TPB is defined as the extent to which a person is in volitional control to perform a behaviour. The limitation of not being in control is present even if the intention to perform a behaviour is given. Ajzen argues that the resources and opportunities available to a person determine their probability of behavioural achievement (Ajzen, 1991). Perceived behavioural control refers to the totality of the extent an individual is in control of a behaviour. As it is sometimes difficult to estimate the totality of the concept, perceived behavioural control will be substituted in this master thesis by two different concepts that approximate perceived behavioural control. The two concepts that approximate perceived behavioural control are cost perception and convenience perception. Hereby, cost perception refers directly to the resources an individual possesses or does not possess. Secondly, convenience perception refers to the opportunities an individual possesses for using or purchasing bio-based plastic products. As bio-based plastic is a comparatively new product type, costs and convenience are the two types of limitations mostly experienced by the consumers. If a product is not readily available this inhibits the possibility to use bio-based plastic products. Along the same lines, if a product of bio-based plastic nature is perceived as too expensive in comparison to conventional fossil-based plastic, limited resources decrease the intention to use bio-based plastic products. In the following, both concepts are explained in depth with the respective hypotheses.

3.2.2.1. Cost Perception

The first influence on perceived behavioural control that is measured in this master thesis and more directly corresponds to required resources to perform a behaviour is cost perception. Within the literature on green consumption, resource expense is often researched and is considered an important product attribute. According to economic theories, consumers generally prefer products with lower prices (Scherer et al., 2018a) and the often higher prices

of green products serve as deterrents (Testa et al., 2021). This has been demonstrated for example by Lynch et al. (2017) who found in their study on several bio-based technologies that high costs were a deterrent for consumers to use these technologies.

Most of the times, the variable that is examined in research is willingness-to-pay (WTP) or the price premium consumers are willing to pay in exchange for a more environmentally-friendly product. Within the context of TPB, price is a measure for perceived behavioural control as it limits the possibilities of a consumer's actual purchasing (Testa et al., 2021). In the following, some of the research within the green consumption literature regarding price will be examined.

There are several studies within the field showing that consumers are willing to pay a moderate price premium for bio-based plastic products (Gaffey et al., 2021; Kainz, 2016; Klein et al., 2020; Ruf et al., 2022; Scherer et al., 2017, 2018a, 2018b; Zwicker et al., 2021, 2023).

In a comparatively early study Kainz (2016) found that in an auction experiment, consumers valued products made of biopolymers higher that conventional products. Moreover, the consumers of this study also demonstrated a WTP that was higher for bio-based plastics than for plastics from conventional sources, albeit by only a small amount.

The higher WTP for a bio-based plastic product was demonstrated in several different product categories. In a study regarding bio-based outdoor sporting equipment Scherer et al. (2018a) found that consumers generally were interested in the bio-based alternative while price was the second most important attribute. Respondents preferred the cheapest variant and increased prices decreased utility in addition to the high premium to outrightly being rejected. It can be inferred that very high prices deter demand for bio-based plastic products (Scherer et al., 2018a). When looking at sports equipment, Scherer et al. (2018b) demonstrated that consumers prefer products with a high amount of bio-based material and accept a limited price premium for them. At the same time, respondents with less interest in bio-based plastic products prefer

both lower prices and products made from conventional plastic (Scherer et al., 2018b). For a similar product category, Notaro et al. (2022) found that for both bio-based plastic jackets and disposable cups, consumers preferred 100% wood-based plastics. As with other product categories, they confirmed that consumers were willing to pay a premium for the more sustainable option but at the same time are still price sensitive as they prefer the lower price premium for the higher priced bio-based product. They concluded that the more the price of the product increased the less likely the product is chosen (Notaro et al., 2022). Morone et al. (2021) have demonstrated also for hand soap, food bags, and coloured pens that consumers with a higher WTP are more inclined to buy bio-based products and vice versa. In addition, price elasticity is lower for bio-based products than for conventional products (Morone et al., 2021).

The price premium for bio-based plastic products has also been shown to exist in different countries, for example, Gaffey et al. (2021) demonstrated in their study investigating different consumer product categories that consumers in Ireland and the Netherlands are willing to pay a price premium for the more sustainable plastic product and that price is an important criterion for choosing a specific product. The existence of the price premium has also been shown for Germany, e.g., Kainz (2016); Scherer et al. (2018b), Italy, e.g. Morone et al. (2021); Notaro et al. (2022), and the UK (Zwicker et al., 2023).

The actual size of the price premium that consumers are willing to accept for bio-based plastic products is differing by product category with Gaffey et al. (2021) showing that the largest premium was accepted for the categories of disposable products, and cosmetic and personal care (25-50%). In another study regarding bio-based beverage bottles, Zwicker et al. (2023) found that consumers were willing to pay up to 40% more for the bio-based version of the product.

In this master thesis, not actual WTP is observed but instead the construct cost perception. WTP is not used as bio-based plastic materials are not yet widely available and as such only limited

experiences were made with acceptable price premiums. Cost perception was also used in previous studies regarding bio-based plastic products such as Niedermeier et al. (2021) and can be used in the TPB as a factor influencing perceived behavioural control as it refers to the evaluation of a consumer's resources.

In an in-depth study by Sijtsema et al. (2016) in the Czech Republic, Denmark, Germany, Italy, and the Netherlands, perceived higher costs was one of the aspects respondents evaluated negatively in regard to bio-based products. Similarly, Lynch et al. (2017) found in a study on Dutch consumers, that they also perceived higher costs as limiting factor on the distribution of bio-based technology such as bio-based plastic products.

In conclusion, cost perception is a principal factor in the purchase decision and acts as a barrier to choosing a bio-based plastic product. Consumers value bio-based plastic products and their environmental friendliness and are willing to pay a limited price premium for them. The specific amount depends on the product category, the consumer in question, for example on whether they perceive the protection of nature as important, and the amount of information a consumer is provided by the product. Based on the previous literature, there is a point at which each consumer evaluates a bio-based product as too expensive and is not willing to adopt it. Due to this, the following hypothesis is proposed:

H7a. Cost perception negatively influences Intention to use bio-based plastic products.

3.2.2.2.   Convenience Perception

Convenience perception is the second concept that replaces perceived behavioural control in this master thesis. According to Ruf et al. (2022) it is an influencing factor not researched in depth regarding bio-based products.

One way to characterise perceived personal inconvenience is how customers feel about (and are reluctant to) exert "personal efforts" when making environmentally friendly product

purchases (Barbarossa & De Pelsmacker, 2016; Follows & Jobber, 2000, p. 727). In other words, it refers to the effort that consumers need to make to recognise and find bio-based products in the market (Ruf et al., 2022). Within the field of environmentally-friendly purchases, Gupta and Ogden (2009) described that consumers experience environmentally-friendly purchasing as time consuming, economically disadvantageous, and a stressful activity because they need to invest additional resources (Barbarossa & De Pelsmacker, 2016). To reduce the individual effort and as such reduce negative consequences (for example paying more for environmentally friendly products, going to specialised stores, or recognising environmentally-friendly products on the shelf), consumers evaluate environmentally-friendly purchasing as less favourable. This in turn can be seen as a motivation to not engage in environmentally-friendly purchasing behaviour (Barbarossa & De Pelsmacker, 2016).

Bio-based plastic products are part of the more environmentally friendly product category and due to their characteristics and not yet widely being available, not easily recognisable for consumers. Consequently, purchasing bio-based plastic products is more difficult than purchasing conventional products (Ruf et al., 2022). Due to this, one can expect that perceived inconvenience is higher for bio-based plastic products and as such limits the intention to use bio-based plastics. In result the following hypothesis is proposed:

H7b. Perceived convenience negatively influences Intention to use bio-based plastic products.

3.2.3. Control Variables

3.2.3.1. Previous Product Experience

One of the control variables which is used in addition to TPB in this master thesis is previous product experience. As many consumers are not aware of the existence of bio-based plastic products, there is limited knowledge and experience related to them (Ruf et al., 2022). Similarly, it is difficult to distinguish between conventional plastic and bio-based plastic, as they appear

similarly and have most of the same attributes (Klein et al., 2019). Due to this, actual experience with a bio-based plastic product might be necessary in order to be able to recognise their existence and to be able to distinguish them from conventional plastic products. Moreover, it was demonstrated in the literature that prior behaviour such as a purchase or a switch to green products can influence purchase intention in the future (Blesin et al., 2017; Reinders et al., 2017). Khare and Sadachar (2017) showed in their study on green apparel buying behaviour of Indian youth that past green behaviour is an important predictor to green apparel buying behaviour. According to the authors, youth that use environmentally friendly products are aware of their benefits, and as such are more inclined to acquire information about green products. Similarly for the product category of bioplastics, Klein et al. (2020) found in their study on the perception of bio-based rain jackets in Germany that people without prior experience with green products tend to reject rain jackets based on bio-material. Lastly, Russo et al. (2019) found in their representative study on perception of bio-waste products in the UK that experience with eco-friendly products affects purchase intentions. Previous product experience thus is associated with green consumerism and if a person decided to buy green products in the past, they are more likely to also purchase other green products in the future.

In contrast, Ajzen (1991) posits that the incorporation of past behaviour into a TPB model should not markedly improve the prediction of future behaviour if the other variables in the model effectively capture the underlying variance. Accordingly, the determinants of past behaviour may be employed to evaluate the sufficiency of a model in predicting future behaviour. In a subsequent publication, Ajzen suggests that any effects of past behaviour that influence future behaviour can be attributed to the fact that, for the majority of repeated behaviours, the influences of the past decisions are also present within future decisions. Therefore, if the decision situation remains unaltered and neither the surrounding factors nor the behavioural intention undergo a change, the future behaviour will be analogous to the past

behaviour. In the context of bio-based plastics, if the decision situation to adopt bio-based plastic in the past is consistent to the one in the future, it can be anticipated that the decision remains unchanged and thus the behaviour is repeated (Ajzen, 2002b). Ajzen suggests that observable effects of past behaviour on future behaviour may be influenced by the degree of ambivalence, indifference, or uncertainty associated with attitudes and intentions. These factors may contribute to an instability in the guidance provided by attitudes and intentions, which may subsequently impact the predictability of future behaviour. (Ajzen, 2002b). Empirical research has demonstrated that past behaviour is a reliable predictor of future behaviour in such circumstances. Conversely, this effect is negated when attitudes and intentions are strong and well-formed (Ajzen, 2002b). As the product category bio-based plastic products is relatively unknown to consumers and respondents may be characterised by uncertainty regarding them, it is assumed that past product experience may have a significant influence on attitude and intention.

3.2.3.2.Influence of Socio-Demographic Factors on Intention

The last variables included in the analyses within this master thesis are several socio-demographic characteristics of the respondents. The literature in the field green products on the influence of socio-demographic factors on intention to buy or used has mixed findings (Scherer et al., 2018b). These mixed results were also found in the research on bio-based plastic products. While some researchers found that specific factors had influence on intention, others found that there was no such effect. In the literature on green products in general and bio-plastics in specificity, socio-demographic variables were often used as control variables (Testa et al., 2021).

The first variable within the socio-demographic context was age. Age was not found to be influential on purchase decisions regarding bio-based plastic products by Scherer et al. (2018b), Klein et al. (2019), Niedermeier et al. (2021), Scarpi et al. (2021), and Testa et al. (2021). On

the other hand, Gaffey et al. (2021) and Notaro et al. (2022) found that younger consumers have higher preferences for bio-based plastic products. Additionally, Russo et al. (2019) demonstrated in their study on products made from bio-waste that older consumers had a higher WTP. Scherer et al. (2018b) found that older consumers tend to be more interested in bio-based products. As such there is no clear expectation on which age group intends to use bio-based plastic products more. In general, it is expected that age has a significant influence on intention to use bio-based plastic products.

When looking at gender there seems to be a slight tendency that women are more interested in purchasing bio-based products (Scherer et al., 2018b). Notaro et al. (2022) and Niedermeier et al. (2021) showed that women have more previous purchasing experience with bio-based products. Notaro et al. (2022) also demonstrated that women have a higher purchase intention for disposable cups. In addition, Kainz (2016), Rumm (2016), and Scherer et al. (2018a) showed that women have a more favourable attitude toward bio-based plastic. In contrast, Scherer et al. (2018b), Klein et al. (2019), and Scherer et al. (2017) did not find gender to be a significant influence while Gaffey et al. (2021) found only limited variance between the genders. As there is a slight tendency that women are more interested in using bio-based plastic products in the literature, it is expected that women have a higher intention to use bio-based plastic products.

When looking at the influence of education on intention to use bio-based plastic, Klein et al. (2019) found that it has no influence on the purchase intention of bio-based plastic in Germany. In contrast, Notaro et al. (2022) found that the variable high school diploma had a high influence on increasing purchase of bio-based products. In their literature review on drivers of green consumption, Testa et al. (2021) concluded that except for gender, none of the demographic factors including education seem to show a significant effect on intention to purchase a green product. As there have been some studies looking at specifically bio-based products and intention to purchase which found a positive influence of education it is expected within the

context of this master thesis that education has a significant positive impact on intention to use bio-based plastic, meaning that the higher the school level, the higher the intention to use bio-based plastic products.

Lastly, income might play a role in the intention to use a bio-based plastic product. Kainz (2016) found that income level had a significant influence on WTP with a higher income leading to a lower WTP. In contrast, Scherer et al. (2017) found in their study on segmentation of consumer groups for bio-based sand toys that none of the demographic data was significantly different between the found consumer segments. As a limited available income means decreased available resources to buy products and the price of bio-based plastic products at the moment is higher than for conventional products, it is expected that lower income has a negative effect on the intention to use bio-based plastic products.

4.   Empirical Investigation

4.1.   Study Objectives, Research Model, and Hypotheses

This master thesis aims at identifying and investigating factors that influence consumers' decisions expressed by attitudes and intentions to adopt or use bio-based plastic products. To achieve this, a research model was created based on TPB and including extending factors following the literature research. The extension factors used in this thesis were selected based on previous research on either more generally green product consumption or specifically behaviour regrading bio-based plastic products. In order to extend TPB, several additional variables are added which influence Attitude or Intention. Additionally, two variables were introduced to replace perceived behavioural control. The independent variables used for the extension are two variables regarding the environmental outlook of the consumer, Green consumer values and Perceived consumer effectiveness, and two variables regarding general consumer characteristics, Habit and Trust. Additionally, perceived behavioural control is

approximated by Cost perception and Convenience perception. Lastly, the control variables, Previous product experience, Gender, Age, Income, and Level of Schooling are added.

The empirical investigation consequently has three main objectives:

1. To examine the factors -Attitude and Subjective norm- that influence Intention to use bio-based plastic products based on the framework of the TPB.

2. To investigate how the TPB can be extended by four different constructs Green consumer values, Perceived consumer effectiveness, Habit, and Trust- which are expected to have significant influence on Attitude toward and Intention to use bio-based plastic products.

3. To assess whether perceived behavioural control can be approximated by Cost perception and Convenience perception in the field of bio-based plastic products.

The following model shows the investigated relationships within this empirical investigation.

Figure 5: Research model
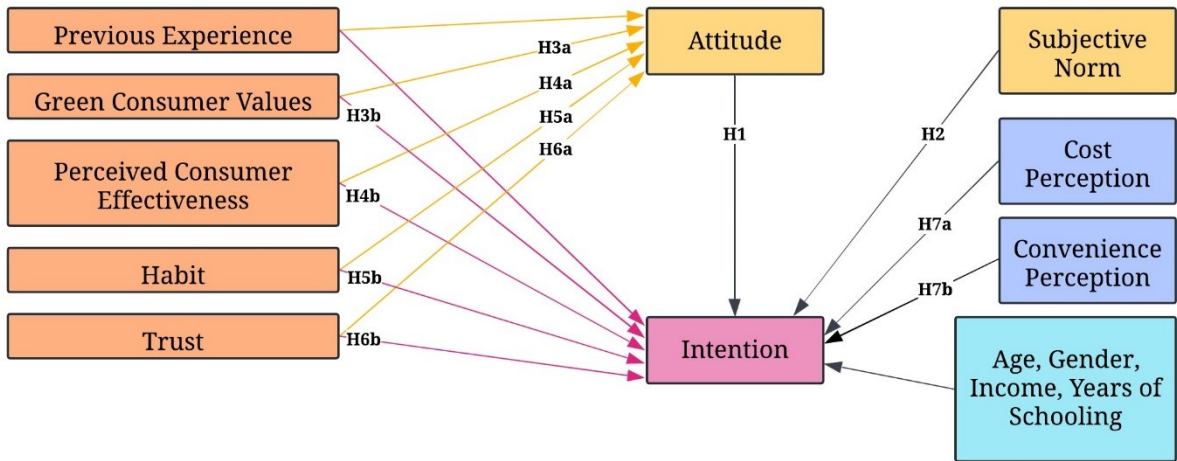
Source: Own illustration

The research model shows the twelve hypotheses which are investigated in this research. The hypotheses were developed based on the original TPB model by Ajzen (1991) in addition to ten hypotheses derived from the literature review.

Table 1: Hypotheses and expected effects

H1 (+)	H1. A positive Attitude toward bio-based plastic products positively influences intention to use bio-based plastic products.
H2 (+)	H2. High social pressure (Subjective norms) positively influences Intention to use bio-based plastic products.
H3a (+)	H3a. Green consumer values positively influence Attitude toward bio-based plastic products.
H3b (+)	H3b. Green consumer values positively influence Intention to use bio-based plastic products.
H4a (+)	H4a. Perceived consumer effectiveness positively influences Attitude toward bio-based plastic products.
H4b (+)	H4b. Perceived consumer effectiveness positively influences Intention to use bio-based plastic products.
H5a (-)	H5a. Habit negatively influences Attitude toward bio-based plastic products.
H5b (-)	H5b. Habit negatively influences Intention to use bio-based plastic products.
H6a (+)	H6a. Trust positively influences Attitude toward bio-based plastic products.
H6b (+)	H6b. Trust positively influences Intention to use bio-based plastic products.
H7a (-)	H7a. Cost perception negatively influences Intention to use bio-based plastic products.
H7b (-)	H7b. Convenience perception negatively influences Intention to use bio-based plastic products.

In order to examine the hypotheses two multiple linear regressions were performed, on Attitude toward bio-based plastic products, and Intention to use bio-plastic products. Furthermore, two mediation analyses were conducted to obtain additional insights into the relationship between Green consumer values, Attitude, and Intention, as well as between Perceived consumer effectiveness, Attitude, and Intention.

4.2. Survey

4.2.1. Research Instrument

In order to implement the study, it is necessary to collect quantitative data. This was done via an online survey. The choice of an online survey provides several advantages within the context of this master thesis.

First, the survey was intended to gather consumer opinions on bio-based plastic regardless of age or other factors such as previous knowledge or experience. As such an online survey without any preconditions was assessed to be a reasonable tool for the gathering of data. Second, the survey was intended for an English-speaking population not bounded by regional or country-level specifications. This resulted in a higher response rate than other types of data gathering would typically result in. Third, an online survey is accessible at all times, leaving it up to the respondents at which time and speed they prefer to answer the questions (Evans & Mathur, 2005). In addition, the accessibility from different locations through different devices, such as a desktop computer, smartphone, tables, an online service also increases the convenience for participants (Wright, 2005). Fourth, answering an anonymous survey, participants might be more honest about their thoughts and opinions compared to answering questions face-to-face. This leads to more accurate data as the social desirability and interviewer effects are mitigated (Dillman et al., 2014, pp. 157-162).

4.2.2. Measurement

4.2.2.1. Dependent and Independent Variables

The constructs (Attitude, Habit, Trust, Green consumer values, Perceived consumer effectiveness, Subjective norm, Perceived cost, Perceived convenience, and Intention) each were measured by a block of questions that respondents were asked to answer on a 7-point Likert scale. The possible answers ranged from completely disagree (=1) to completely agree

(=7) with a midway point to reduce the potential of overload to one side due to forcing the respondents to answer the questions. This is especially important as every question was mandatory to be filled in.

Each of the questions was based on previous research in green consumption behaviour or specifically in the bioplastic field. Due to this, the question items and concepts were tested within previous studies on the unambiguity and reliability and thus can be adapted for the purpose of assessing intention to adopt bio-based plastic. The following section will present the sources from which the question items originate. The complete overview with the specific question items is attached in Appendix B.

The questions regarding the concepts of Subjective norm and Intention are based on Gutiérrez-Taño et al. (2022). The researchers were using these question items in a survey which examined an extended TPB to predict Intention to use bioplastic. Attitude is based on Taylor and Todd (1995) who examined the antecedents of recycling and composting intentions with the TPB. As recycling and composting is a particular part of the plastic life journey the measures could be adapted to the context of bio-based plastic. Alongside the adaption of the question items to the different context, the scale was adapted to being a 7-point Likert scale from 1 to 7 instead of one from -3 to +3.

The extension factors for the TPB are based on diverse sources. Adapted from Niedermeier et al. (2021) are Perceived consumer effectiveness, Habit, and Trust. The researchers examined these among other constructs as the drivers and barriers of consumers to buy bio-based glue sticks. Green consumer values are adapted from Gutiérrez-Taño et al. (2022) as they were already tested for specifically bioplastic products. Lastly, the question items for Cost perception are adapted from Notaro et al. (2022) who assessed purchase drivers for bio-based products. In order to align with the other 7-point Likert scales, the 5-point scale of Cost perception was

adapted. This was done in order to ensure greater uniformity in the survey, thereby facilitating comprehension on the part of respondents.

The items for each construct were randomised in their order to decrease potential bias for specific options. To check comprehensibility and detect any problems or errors before the data gathering, the survey underwent pretesting with three different people.

4.2.2.2. Control Variables

Alongside the dependent and independent variables, some control variables were employed in the survey. The control variables included the inquiry into the respondents' awareness and previous purchase experience. The question regarding the awareness of the existence of bio-based plastic had three possible answers *("Yes, I have heard of bioplastic before and know exactly what it is."; "Yes, I have heard of it before."*; and *"No, I have never heard of it."*). The question regarding previous purchase experience ("*Have you ever deliberately opted for bioplastics?*") had two possible answers ("*Yes*" and "*No*"). Both of these question items were based on Klein et al. (2019) who examined these concepts in the context of bioplastic use intention. In addition, the survey included socio-demographic questions regarding Gender, Age, Income, Level of schooling, Country of origin, and Country with longest residency.

4.2.3. Survey Structure

The survey was structured in three main parts which were distributed over six pages. The introduction part briefly introduced the topic of the study. The specific research objectives were not disclosed in order to receive unbiased responses. In addition, the data usage and privacy disclaimer were included. If participants were in accordance with the disclaimer, they could proceed to the next section and start the actual main part of the survey.

At the beginning of the next section, a brief description of the characteristics of bio-based plastic in addition to its differences to conventional plastic was included. Moreover, some advantages

and disadvantages were included and usage areas mentioned. Afterwards, the respondents were asked about their knowledge and previous purchase behaviour regarding bioplastics. These questions were aimed at gathering information about the research sample and their Previous product experience and familiarity with bioplastic. It also served to introduce respondents to the topic and give some limited knowledge to those who are not as familiar with the concept of bio-based plastic. The last questions in this section were regarding the participant's Attitude toward bio-based plastic.

In the next section, respondents were asked about the experienced influences in their purchasing decisions regarding bio-based plastic products. Subsequently, they were asked about their agreement to varying questions regarding Cost perception and Convenience perception.

Within the next section, the focus was on the respondent's green consumer behaviour. The respondents were first asked to indicate their opinion on a series of questions regarding the importance of their purchase decision not having a negative impact on the environment and their alignment with Green consumer values. Secondly, the questions concerning Perceived consumer effectiveness were designed to evaluate the perceived impact that an individual's own decisions and actions can have on the broader issue of environmental degradation. Afterwards, the participants were asked to indicate their Intention to buy or opt for bio-based plastic products in the future.

The fifth section aimed at gathering information about specific consumer characteristics. First, questions regarding the respondent's Habits towards specific products, brands, and stores were asked. Subsequently, the respondents answered questions regarding their Trust in the honesty of companies producing bio-based plastic products and eco-labels.

At the end of the survey, respondents were asked to respond to several socio-demographic questions. They indicated their age range, gender, highest level of schooling, households' monthly income, country of residence, and country they lived in for the longest time.

After completing the main body of the survey, the respondents reached the ending page where they were thanked for their participation and given the email of the researcher for further information or to express remarks.

4.2.4. Survey Implementation

The survey questionnaire was created with SoSci Survey (Leiner, 2024) which is an online survey tool with its own servers first developed in 2003 by the Institute for Communication Science and Media Research at the Ludwig-Maximilians-University in Munich, Germany. SoSci Survey allows for quick but at the same time very flexible survey design by providing pre-fixed question types that are adaptable to the researcher's intent. Simultaneously, it offers a streamlined data collection and processing mechanism, facilitating the transfer of collected data to a range of software formats for download. This enables the seamless integration of the data into other software applications. In addition, the tool facilitates data cleaning as it provides several measures for quality, such as the response duration for each of the parts of the survey and the total response duration. Lastly, the tool allows to set questions to mandatory and thus helps in receiving more complete data sets thus improving the quality of the data set for analysis.

The survey was distributed via convenience sampling, whereby the survey link was shared through various social media channels, including Instagram, and WhatsApp. The survey was conducted between 26th of July until 18th of August 2024. In total, the survey was accessed 228 times over the 24-day period, which constituted the data basis for the subsequent analysis. The mean completion time for the survey was 7 minutes and 3 seconds.

5. Data Analysis and Research Result

5.1. Data Preparation

Before the analysis with the statistics tool IBM SPSS, the data first had to be prepared and cleaned. The data collection resulted in 228 data points which includes all accesses to the survey, whether from a link or by appearance in the browser. This number also includes the started but not finished surveys.

After deleting the data points which referred to people only accessing but not starting the survey there were 185 data points left, which were further examined to increase the quality of the data sample.

In order to only include viable data into the analysis, the total time spent on the survey was assessed. It was decided to not delete any of the respondents who needed a longer timeframe for the survey. One potential explanation for the longer completion time is that the topic is highly specific and that bio-based materials are not as widely distributed or well-known. Furthermore, it is possible that the participants may have devoted additional time to considering their potential response, conducting research, or taking a brief intermission. Moreover, the respondents who are not fluent in English may have needed additional time to completely understand the survey and what was asked of them. Considering these considerations, no participants with a high response duration were excluded. On the side of the completion duration spectrum, the lowest response times were examined as it is not feasible to correctly fill in the survey completely and reading all the stimulating texts in one to two minutes. There were no cases that fulfilled the criterium and as such no data points were excluded due to time restrictions.

In addition, the response variance was checked in order to detect respondents who have little or no response variance. As Greszki et al. (2015) argues, these so-called "speeders" add random

noise to the data and attenuate correlations even if they do not substantially change effects and effect sizes. Still, in best practice it is recommended to remove speeders as they put little to no thought in their answers. When looking at the data base only one respondent has too little variance and as such, 184 data points are left for the data analysis.

After the completion of the data base, some of the data was recoded. This pertains to the question items that exhibit a contradictory interpretation in comparison to the other items within a construct. The items were recoded in order to ensure that the meaning was consistent across all question items. This recoding was done for *Perceived consumer effectiveness*, were items 1 ("*It is worthless for the individual consumers to do anything about pollution.*") and 3 ("*Since a lone individual cannot have any effect on pollution or the over-exploitation of natural resources, it doesn't make a difference what I do.*") were re-coded in such a way that 1 means completely agree and 7 means completely disagree. In the same way, item 3 of the construct *Habit* was recoded ("*I change brands regularly.*") so its meaning follows the other items within the construct.

As each item in the questionnaire was mandatory to answer, no single responses were missing in the general section regarding the topic of bio-based plastic. The missing occurring within this section are the result of respondents not finishing the complete survey.

As is best practice for surveys, a response option was provided within the socio-demographic section for respondents who were not willing to answer the question due to their rather sensitive nature ("*Prefer not to answer*"). Within the data collection these answers were recoded to be shown as missing answers.

The subsequent phase of the process entailed the transformation of the ordinal data into metric scales, thus enabling its utilisation in the analytical procedures. In order to achieve this, the following steps were undertaken.

Age was recoded into averages for each of the age brackets. In the absence of an upper limit for the uppermost bracket, an approximation was required. It was decided to look at the demographic data of Germany pertaining to life expectancy for the age group of 60 and above. This was due to the fact that, with the exception of two cases, the respondents aged 60 and above indicated Germany as their country of origin. The life expectancy for seniors aged 60 in Germany in 2021/2023 was determined to be 71.59 (2024). The mean age for the age bracket of 60 and older was then calculated as the mean between 60 and the aforementioned average life expectancy.

For Income, the responses to the categories were also recoded into numerical values presented by the mean of each income bracket. For the highest income bracket which was open to even higher income it was decided to use the same addition to the mean as with the other brackets given the absence of further information regarding the size of income.

The variable Schooling level was converted into years of schooling in accordance with the International Standard Classification of Education (ISCED 2011). The completion of elementary and middle school is equivalent to eight years of schooling, while the attainment of a high school degree represents 12 cumulative years of schooling. The completion of a bachelor's degree or a master's degree results in a total of 15 or 17 years of formal education, respectively.

Lastly, the coding for Gender was adapted into being 0 for male and 1 for female. As there was only one respondent who checked the box for diverse, this answer was changed to "N*ot answered"* in the data base.

5.2.   Sample Profile

In total there were 184 data points that were part of the data base. The tabular overview of the socio-demographic data is presented in Appendix C. Within the following section, a brief

overview of the respondent sample in terms of their socio-demographic characteristics and their previous experience and knowledge about bio-based plastic is provided.

The sample is skewed toward female respondents as there were 104 women (56.52%) compared to 55 men (29.89%), one other (0.54%), and 24 (13.04%) who did not answer.

Figure 6: Gender distribution
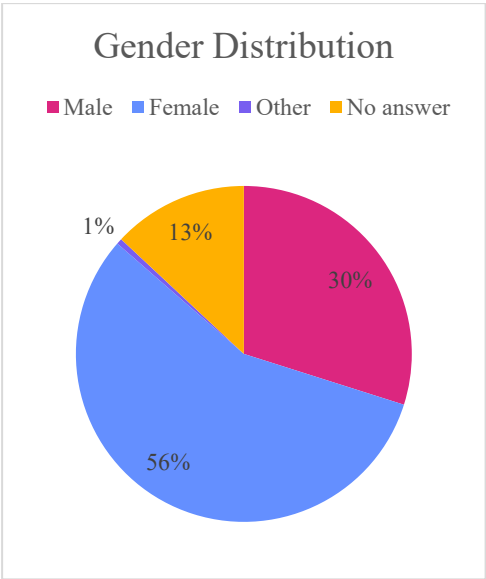
Source: Own illustration

In terms of age, the most populated age bracket was those from 20-29 (57.61%) as those are the people that were easily reached by the distribution methods of WhatsApp and Instagram. The second largest group was tied between those 60 and older, which was a comparatively large age bracket, and the ones that gave no answer, with each 11.41%.

Figure 7: Age distribution

Age Distribution (in %)

Legend:
- 16-19
- 20-29
- 30-39
- 40-49
- 50-59
- 60 and older
- No answer

Values: 2,17 · 11,41 · 11,41 · 7,07 · 4,89 · 5,43 · 57,61
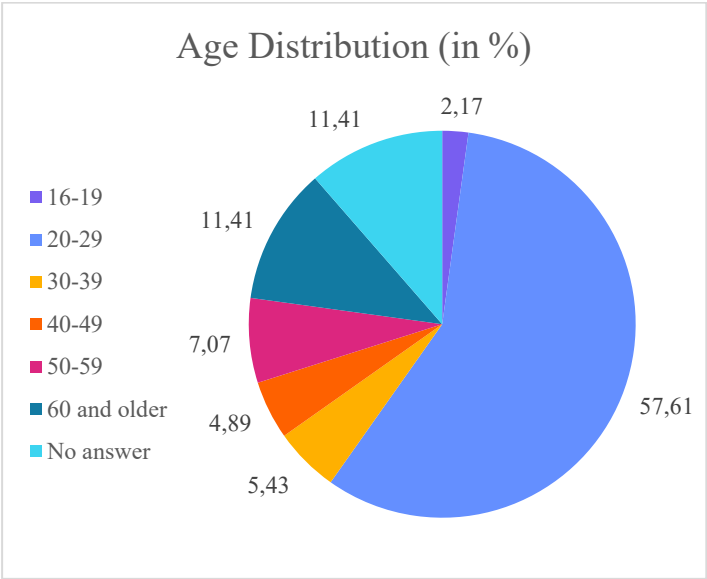
Source: Own illustration

With regard to the level of schooling, the largest group was comprised of individuals holding a bachelor's degree (37.5%), followed by those holding a master's degree (28.26%), and those holding a high school degree (19.02%). This leads to the conclusion that the sample exhibits a higher level of education than the general population.

Figure 8: Level of schooling

Level of Schooling (in %)

Elementary/ Middle School Degree	High School Degree	Bachelor Degree	Master Degree	Not answered
2,72	19,02	37,50	28,26	12,50
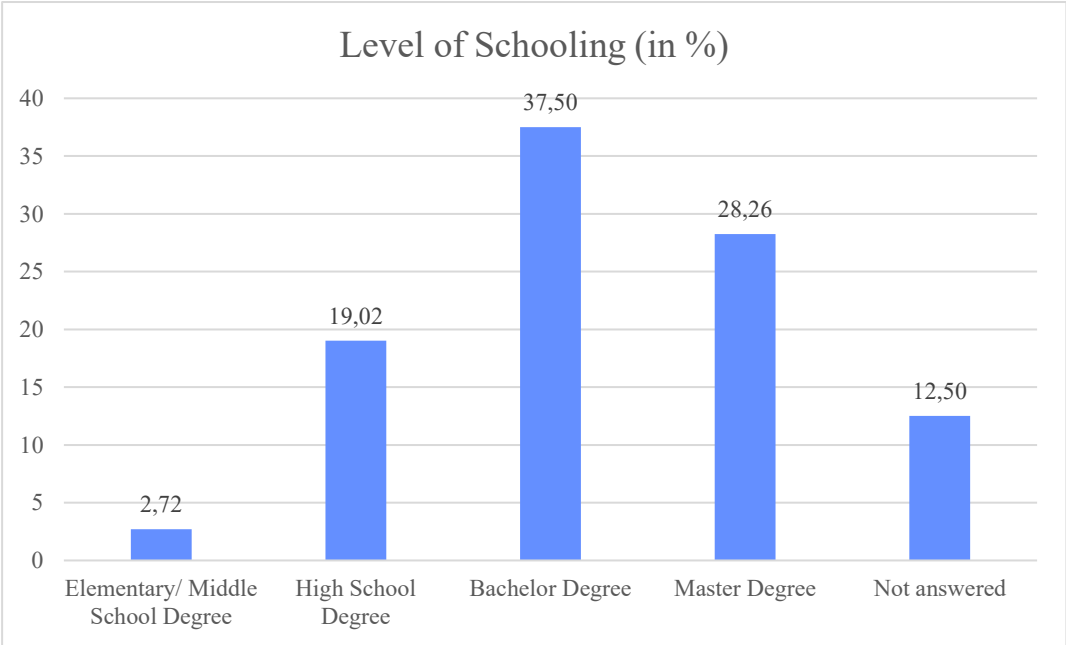
Source: Own illustration

Within the answers to the question on income, one could see that income seems to be the most sensitive of the questions regarding the socio-demographic characteristics as the most answered category was *"Prefer not to answer"* or no answer was given (27.72%). The largest category with an answer was the category representing a monthly income of 3,000€ and more (20.65%) and the income bracket that indicates a monthly income of 500€-1,000€ (19.02%). With this question, both the extremes have a large amount of weight while the middle does not seem to be as represented in the sample.

Figure 9: Income distribution
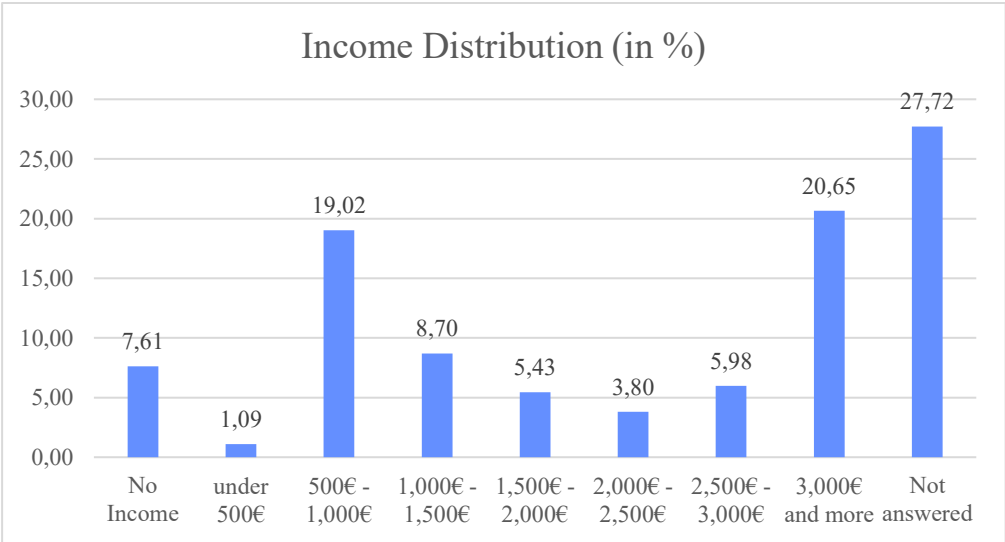
Source: Own illustration

Additionally, two questions regarding the Previous experience and Perceived knowledge of the respondents were asked to gather information on the awareness of bio-based plastic within the sample. Confirming the findings from the literature, most of the consumers of the sample have limited Perceived knowledge about bioplastics with 59.24% answering that they have heard of it before, while only 20.11% answered that they knew exactly what bioplastic is.

Figure 10: Perceived knowledge about bioplastic (in %)

Perceived Knowledge about Bioplastic (in %)

No, I have never heard of it.	20,65
Yes, I have heard of it before.	59,24
Yes, I have heard of bioplastics before and I know exactly what that is.	20,11

0,00 10,00 20,00 30,00 40,00 50,00 60,00 70,00
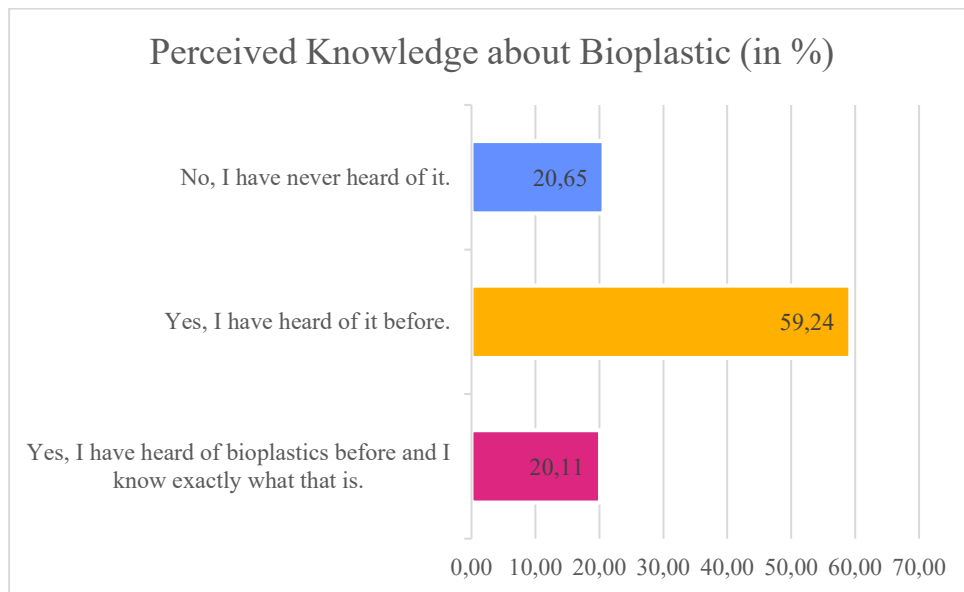
Source: Own illustration

In accordance with the previous literature, the sample also has limited usage experience with bioplastic as 68% of the respondents expressed that they had not used bioplastic before.

Figure 11: Previous experience with bioplastic

Previous experience with bioplastic

■ Yes ■ No

32%

68%
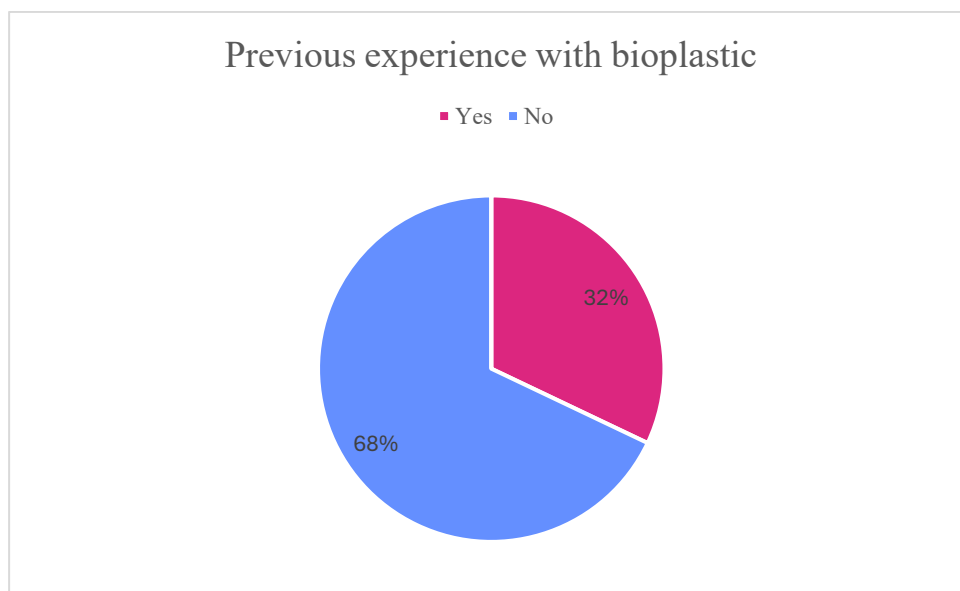
Source: Own illustration

After looking at the descriptives for Previous product experience and Perceived knowledge of respondents, the overlap of the concepts was assessed. As would be expected, respondents who

had no knowledge and used bioplastics before were extremely limited (1.1%) while those that expressed that they previously did not use bioplastics and had no knowledge about them was a larger group (19.57%). On the other end of the spectrum, those that reported "perfect knowledge" (*"Yes, I have heard about bioplastics before and I know exactly what that is"*) and also used bioplastics before were only the 4th largest group (11.41%). Less respondents answered that they had perfect knowledge but did not previously use bioplastics (8.70%). The by far largest group of respondents answered that they did not use bioplastics before while they have heard of them (39.67%). Lastly, the respondents that answered that they previously used bioplastics and have heard of them before is also the second-most populated group (19.57%). This is in line with previous research findings about the distribution of bioplastics in the population and the knowledge that consumers have about them (Blesin et al., 2017; Dilkes-Hoffman et al., 2019; Sijtsema et al., 2016).

Table 2: Overlap Previous usage and Perceived knowledge of bioplastics

Previous Usage of Bioplastics	Perceived Knowledge about Bioplastics		
	Yes, I have heard about it before and I know exactly what that is.	Yes, I have heard of it before.	No, I have never heard of it before.
Yes	21 (11.41%)	36 (19.57%)	2 (1.1%)
No	16 (8.70%)	73 (39.67%)	36 (19.57%)

The last variables that were asked for within the survey are country of origin and longest lived in country. The by far largest group of respondents is from Germany (n=108) with also the largest group of people living most of their life there (n=118). The second largest group is originally from Italy (n=26) and the third largest from Switzerland (n=8). The second largest

group for where people lived most of their life is Italy (n=10) and the third largest is Switzerland (n=4). For both categories 29 respondents selected to not answer the questions. The full table of the responses to these two questions is in appendix C.

5.3. Internal Consistency and Correlation Examination

To analyse the data, the software IBM SPSS Statistics in the version 29.0.2.0 was used.

In order to summarise the items of the questionnaire into their variable constructs their internal consistency needed to be assessed. To achieve this, Cronbach's Alpha (α) was calculated for both original TPB constructs and additional extending the TPB constructs. According to Hair et al. (2019), values greater than 0.6 are acceptable. The reliability statistics of the constructs Trust (α=0.932), Green consumer values (α=0.852), Intention (α=0.823), and Attitude (α= 0.818) all showed very high (≥0.8) or excellent (≥0.9) values. The constructs Habit (α=0.770), Cost perception (α=0.644), Perceived consumer effectiveness (α=0.626) and Subjective norm (α=0.755) also exceeded the threshold of α≥0.6 and showed high item correlations within the sample. As such the question items show to adequately capture the intended constructs. The only construct that did not achieve a satisfactory value for Cronbach's Alpha was Convenience perception (α=0.555) and this was excluded from further analysis. An overview of the constructs' Cronbach's Alphas is provided in table 3 below.

Table 3: Cronbach's Alpha

Variable	Cronbach's Alpha (α)
Intention	0.823
Attitude	0.818
Subjective norm	0.755
Cost perception	0.644
Convenience perception	0.555

Green consumer values	0.852
Perceived consumer effectiveness	0.626
Habit	0.770
Trust	0.932

For items that meet the criterion of having an α>0.6, which are all constructs expect for Convenience perception, a mean is calculated across the question items to form the final constructs. This is done in order to facilitate the representation of the constructs within the subsequent analyses. As the internal consistency of Convenience perception could not be established, it was not considered within the further analysis anymore. Moreover, as Convenience perception was the basis for H3b, this hypothesis was not assessed in any of the further models and as such could not be approved or rejected.

After calculating the means for each of the constructs a correlation matrix was used to assess the linear relationship between them. Any values larger than 0.7 between the independent variables are cause for further investigation as there might be an issue of multicollinearity (Dormann et al., 2013). This is not the case for the variables used within the context of this master thesis as can be seen in the correlation matrix provided on the next page in table 4.

In this master thesis discriminant validity was not assessed, as all of the constructs used were based on previous literature where their discriminant validity was already tested. Moreover, the constructs capture similar and overlapping constructs reducing the need for discriminant validity.

Following comprehensive testing of the constructs in terms of internal consistency and correlation with one another, a subsequent stage is the testing of the hypotheses.

Table 4: Correlation matrix

Correlations

		Intention	Attitude	Subjective Norm	Cost	Green Values	Effectiveness	Habit	Trust	Experience	Age	Gender	Schooling in Years	Income
Intention	Pearson Correlation	1	,473**	,438**	,447**	,565**	,437**	,072	,394**	,108	,153*	,063	-,032	,086
	Sig. (2-tailed)		<,001	<,001	<,001	<,001	<,001	,361	<,001	,165	,049	,419	,683	,272
	N	167	167	167	167	167	167	164	165	167	167	167	167	167
Attitude	Pearson Correlation	,473**	1	,483**	,640**	,309**	,225**	,014	,368**	,096	,211**	,188*	,302**	,253**
	Sig. (2-tailed)	<,001		<,001	<,001	<,001	,004	,860	<,001	,196	,004	,010	<,001	<,001
	N	167	184	175	175	175	167	164	165	184	184	184	184	184
Subjective Norm	Pearson Correlation	,438**	,483**	1	,459**	,274**	,128	,142	,221**	,037	,228**	,179*	,074	,107
	Sig. (2-tailed)	<,001	<,001		<,001	<,001	,098	,070	,004	,623	,002	,018	,331	,157
	N	167	175	175	175	167	167	164	165	175	175	175	175	175
Cost	Pearson Correlation	,447**	,640**	,459**	1	,417**	,153*	-,067	,430**	,045	,254**	,151*	,212**	,240**
	Sig. (2-tailed)	<,001	<,001	<,001		<,001	,049	,392	<,001	,559	<,001	,046	,005	,001
	N	167	175	175	175	167	167	164	165	175	175	175	175	175
Green Values	Pearson Correlation	,565**	,309**	,274**	,417**	1	,576**	,044	,321**	,143	,162*	,080	-,034	,079
	Sig. (2-tailed)	<,001	<,001	<,001	<,001		<,001	,573	<,001	,066	,036	,307	,665	,307
	N	167	175	167	167	167	167	164	165	175	175	175	175	175
Effectiveness	Pearson Correlation	,437**	,225**	,128	,153*	,576**	1	,068	,242**	,016	,202**	,177*	-,018	,068
	Sig. (2-tailed)	<,001	,004	,098	,049	<,001		,389	,002	,839	,009	,022	,817	,383
	N	167	167	167	167	167	167	164	165	167	167	167	167	167
Habit	Pearson Correlation	,072	,014	,142	-,067	,044	,068	1	,066	-,113	,090	,127	-,083	,079
	Sig. (2-tailed)	,361	,860	,070	,392	,573	,389		,403	,149	,252	,106	,292	,315
	N	164	164	164	164	164	164	164	164	164	164	164	164	164
Trust	Pearson Correlation	,394**	,368**	,221**	,430**	,321**	,242**	,066	1	,063	,105	-,015	-,044	,028
	Sig. (2-tailed)	<,001	<,001	,004	<,001	<,001	,002	,403		,421	,179	,852	,574	,723
	N	165	165	165	165	165	165	164	165	165	165	165	165	165
Experience	Pearson Correlation	,108	,096	,037	,045	,143	,016	-,113	,063	1	-,066	,092	,095	,126
	Sig. (2-tailed)	,165	,196	,623	,559	,066	,839	,149	,421		,374	,215	,201	,088
	N	167	184	175	175	175	167	164	165	184	184	184	184	184
Age	Pearson Correlation	,153*	,211**	,228**	,254**	,162*	,202**	,090	,105	-,066	1	,451**	,548**	,508**
	Sig. (2-tailed)	,049	,004	,002	<,001	,036	,009	,252	,179	,374		<,001	<,001	<,001
	N	167	184	175	175	175	167	164	165	184	184	184	184	184
Gender	Pearson Correlation	,063	,188*	,179*	,151*	,080	,177*	,127	-,015	,092	,451**	1	,635**	,268**
	Sig. (2-tailed)	,419	,010	,018	,046	,307	,022	,106	,852	,215	<,001		<,001	<,001
	N	167	184	175	175	175	167	164	165	184	184	184	184	184
Schooling in Years	Pearson Correlation	-,032	,302**	,074	,212**	-,034	-,018	-,083	-,044	,095	,548**	,635**	1	,435**
	Sig. (2-tailed)	,683	<,001	,331	,005	,665	,817	,292	,574	,201	<,001	<,001		<,001
	N	167	184	175	175	175	167	164	165	184	184	184	184	184
Income	Pearson Correlation	,086	,253**	,107	,240**	,079	,068	,079	,028	,126	,508**	,268**	,435**	1
	Sig. (2-tailed)	,272	<,001	,157	,001	,307	,383	,315	,723	,088	<,001	<,001	<,001	
	N	167	184	175	175	175	167	164	165	184	184	184	184	184

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

5.4. Testing of Hypotheses

Before the testing of the hypothesis, a first look at the general perception of the sample in regard to bio-based plastic was taken. The respondents have a fairly positive Attitude toward bio-based plastic products with a mean of 5.7645 (SD=1.1249) on a scale from 1 to 7 (totally disagree to totally agree), with a slightly lower mean of Intention to use bio-based plastic products with 5.4311 (SD=1.0273) on the same scale.

In order to perform a multiple linear regression, several conditions need to be met. In the following, these conditions are briefly discussed before they are used to preface the regression analysis on Intention and Attitude toward the adoption of a bio-based plastic product.

The first condition in order to use a multiple linear regression is that there is a linear relationship between the variables. This can be evaluated by examining the studentised residuals (y-axis) in a scatter plot against the unstandardised predicted values (x-axis). The relationship is assumed to be linear if all the values are grouped around the zero line (y=0). If the relationship between variables is not linear it can lead to biased coefficients (Backhaus et al., 2023, pp. 92-95).

Another condition for the usage of multiple linear regressions is that there do not exist any outliers as they can largely impact an otherwise well-established relationship between two variables. In other words, the condition states that the variables employed within the model are measured without error (Backhaus et al., 2023, p. 101). To examine this, Cook's Distance is used. If Cook's Distance is equal or larger than one, the value is considered to be an outlier and should be excluded from the data set (Stevens, 1984, p. 341).

The next condition is that the residuals of the regression are uncorrelated. In the event that this condition is not satisfied, a variable is found to be correlated with itself, a phenomenon known as autocorrelation. This indicates that the variance along the regression line is no longer random but rather based on previous values. As a consequence, this phenomenon is frequently observed

in time series. Autocorrelation leads to less efficiency of the least-squares estimation which is expressed in the standard errors of the regression coefficients and their p-values. Consequently, the estimation of the confidence intervals become inaccurate. In order to examine the presence of autocorrelation, the Durbin-Watson Statistic is used. The Durbin-Watson Statistic results in the value 2 if there is no autocorrelation between the residuals. For any value close to 2, it can be subsumed that the residuals are not autocorrelated (Backhaus et al., 2023, p. 106ff).

Another condition to be met by the model is that there should not be perfect multicollinearity. Perfect multicollinearity exists when two or more predictors within the model are highly correlated to each other. The existence can confound the size of the predictors, and it is unclear which of the predictors is the one responsible for most of the variance. Multicollinearity can be examined via two separate ways. First, the Variance Influence Factor (VIF) needs to be under 10, better under 5, to assume that there is no multicollinearity present within the model. In turn, this means that the tolerance needs to be larger than 0.1. Second, the correlation values according to Pearson's Correlation need to be smaller than 0.7 in order to conclude that there is no multicollinearity (Backhaus et al., 2023, pp. 110-113).

The fifth condition for a multiple linear regression is that the residuals are normally distributed. This is a condition which needs to be fulfilled in order to be able to perform a number of statistical tests which test for validity such as significance tests and confidence intervals. To conclude whether the residuals are normally distributed, the graphic representation of the distribution of the residuals is examined via a histogram and a P-P Plot diagram. The P-P Plot diagram plots the expected cumulative probabilities of the (sorted) standardised residuals on the y-axis against the cumulative proportions of the observations on the x-axis. If the distribution within the histogram appears to be symmetric similarly to the normal distribution and the values of the P-P Plot diagram are scattered along the diagonal, the residuals are normally distributed (Backhaus et al., 2023, p. 108f).

Lastly, the condition of homoscedasticity is examined. Homoscedasticity expresses that the variance of the residuals of the predicted variable is constant. This condition is of particular significance in the context of regression models, as it serves as an indicator of the model's capacity to predict with consistent accuracy across a range of values. In the event that the variance of the residuals is not constant, the phenomenon is referred to as heteroscedasticity. In order to examine for homoscedasticity, one may utilise a graphical examination, plotting the studentised residuals against the unstandardised predicted values. If the scatterplot has a triangular arrangement there is heteroscedasticity present within the model. This can lead to inefficient estimates and biased standard errors of the coefficients (Backhaus et al., 2023, p. 104f).

All of the following hypotheses are evaluated on the significance level of 5%.

Before assessing the hypotheses an analysis of the baseline model was performed. This includes assessing the significance of the control variables -*Previous product experience, Gender, Age, Years of schooling, and Income*- in a multiple linear regression on *Intention* before adding the main independent variables. The model has an R^2 of 0.050 (adjusted R^2=0.021) with an F (5,161) =1.709, p=0.135 and thus is not significant. Due to this, it can be concluded that the control variables of this research model do not explain the variance of Intention by themselves, and the inclusion of the main independent variables is necessary. The output of the baseline model regression is provided in Appendix D.

5.4.1. Determinants on Intention to Adopt Bio-Based Plastic Products

In a first step of the analysis, the determinants of Intention to adopt bio-based plastic products are assessed. In order to determine the significant influences a multiple linear regression is used. The model includes *Intention* as the dependent variable and the independent variables *Attitude, Subjective norm, Cost perception, Green consumer values, Perceived consumer effectiveness,*

Habit, and Trust. The enter method was used to perform the multiple linear regression and the analysis was based on a 5% significance level. Prior to conducting the analysis, a comprehensive process was undertaken in order to determine whether a multiple linear analysis could be applied as a statistical method. The detailed methodology was described in the preceding section. Consequently, this section will present the results of the preliminary conditions in a concise manner.

The variables showed linear correlations which was determined using the scatter plot of the studentized residuals against the predicted values. No outliers could be detected when checking the Cook-Distance as the highest value was far lower than 1 (0.12435). The Durbin-Watson Statistic had a value of 1.917, indicating that there was no autocorrelation. Moreover, the VIF values were all far lower than the cut-off point with the highest being 2.086. In accordance, no tolerance value smaller than 0.1 was detected so multicollinearity was not present in the sample.

The distribution of the residuals was normally distributed which was determined by assessing the histogram of the residuals against the frequency of them. In addition, the P-P Plot of the residuals was checked also indicting that the residuals were normally distributed. Lastly, the condition of homoscedasticity was examined. For this, the scatter plot of the predicted values against the studentised residuals was assessed. It was determined that the values were equally distributed across the horizontal axis and as such that homoscedasticity was present. Taken together, all of the conditions to run a multiple linear regression were fulfilled and thus a multiple linear analysis could be performed.

The model includes *Intention* to adopt bio-based plastic as a dependent variable. The predictor variables included in this model are *Attitude, Subjective norm, Cost perception, Age, Gender, Years of school, Income, Previous experience, Green consumer values, Perceived consumer effectiveness, Habit, and Trust*.

The R^2 for the overall model was 0.497 (adjusted R^2=0.457), indicative for a high goodness-of-fit according to Cohen (1988). With a value of F (12,151) =12.413 and p<0.001, the model is adequate in determining the Intention to adopt bio-based plastic products. Table 5 presents the regression coefficients, standard errors, and significance levels of the independent variables. The regression analysis showed the following results:

Table 5: Regression on Intention to use bio-based plastic products

Model: n=164, R^2=0.497, adjusted R^2= 0.457, F (12,151) = 12.413, p<0.001							
	B	SE	β	t	Sig	95% Confidence interval	
						Lower limit	Upper limit
(Constant)	-0.103	0.584		-0.176	0.860	-1.256	1.050
Attitude	0.204	0.083	0.197	2.445	0.016*	0.039	0.368
Subjective Norm	0.206	0.067	0.219	3.067	0.003**	0.073	0.339
Cost Perception	0.060	0.080	0.062	0.746	0.457	-0.099	0.218
Age	0.002	0.004	0.033	0.480	0.632	-0.007	0.011
Gender	0.007	0.113	0.004	0.059	0.953	-0.217	0.230
Years of School	0.000	0.022	0.001	0.012	0.990	-0.044	0.044
Income	0.000	0.000	-0.028	-0.408	0.684	0.000	0.000
Previous Experience	0.083	0.132	0.038	0.626	0.532	-0.178	0.344
Green Consumer Values	0.278	0.086	0.256	3.225	0.002**	0.108	0.448
Perceived Consumer Effectiveness	0.173	0.087	0.167	2.226	0.028*	0.019	0.327
Habit	0.013	0.052	0.015	0.243	0.809	-0.090	0.116
Trust	0.089	0.052	0.119	1.720	0.088	-0.013	0.191

Source: Own illustration

The analysis indicates that the following variables, ranked by effect size using the β-coefficients, have significant positive impact on the *Intention* to adopt bio-based plastic products: *Green consumer values* (β=0.256, p=0.002), *Subjective norm* (β=0.219, p=0.003),

Attitude (β=0.197, p=0.016), and *Perceived consumer effectiveness* (β=0.167, p=0.028). The variables *Cost perception* (p=0.457), *Age* (p=0.632), *Gender* (p=0.953), *Years of school* (p=0.990), *Income* (p=0.684), *Previous product experience* (p=0.532), *Habit* (p=0.809), and *Trust* (p=0.088) have no significant effect on the variable *Intention*. In conclusion to these results H1, H2, H3b, and H4b can be supported, while H5b, H6b, and H7a are rejected. When looking at the results, it is interesting to note that the variable *Green consumer values* has a higher effect size than the original variables of the TPB.

The complete output of the multiple linear regression on Intention is provided in Appendix E.

5.4.2. Influences on Attitude toward Bio-Based Plastic Products

In a second step, the influences on Attitude are assessed to extend the TPB. In order to achieve this, all variables are entered into a multiple linear regression model with *Attitude* as the dependent variable via the enter method and evaluated on a 5% significance level. The predictor variables in this model are *Previous product experience, Green consumer values, Perceived consumer effectiveness, Habit, and Trust*. Before interpreting the results, the conditions in order to be able to perform the multiple linear regression must be met. They will be examined shortly in the following. For a more detailed explanation of the criteria, refer to the section at the beginning of the chapter.

First, the linear relationship of the variables needed to be assessed. When looking at the plot of studentised residuals and unstandardised predicted variables, the values were grouped around the zero line and as such a linear relationship could be inferred. Moreover, the assumption that the data set is free of outliers was subjected to scrutiny. A case is considered an outlier if the Cook-Distance is larger than 1. This was not the case within this data set as the highest value was 0.32489. The Durbin-Watson-Statistic led to the value of 1.243, so the model had no autocorrelation. When looking at the Pearson Correlation no value was larger than 0.7 and the

largest VIF had a value of 1.597. As such it could be assumed that there is no multicollinearity present in the model. To examine the condition that the residuals should be normally distributed, a graphic solution with examining the histogram and the P-P-Plot of the standardised residuals was chosen. From examining the graphs, it could be concluded that the residuals were normally distributed. Lastly, in order to check for the condition of homoscedasticity a graphical solution was chosen. The studentised residuals were examined against the unstandardised predicted values. To achieve homoscedasticity, the values within the diagram need to be distributed equally across the horizontal axis. This was the case with this distribution and as such, homoscedasticity was assumed to be present within the data sample.

As all the conditions for the multiple linear regression model were satisfied, in the following the model is evaluated with the dependent variable *Attitude* toward bio-based plastic. With a value of $F_{(5,158)} = 7.071$, the model including the predictors *Habit, Trust, Green consumer values, Perceived consumer effectiveness, and Previous product experience*, is significant ($p < 0.001$) and adequate to determine *Attitude* toward bio-based plastic products. The model has an R^2 of 0.183 (adjusted $R^2 = 0.157$) which indicates a middle or moderate goodness-of-fit according to Cohen (1988) and expresses that 18.3% if the variance in the model can be explained by the independent variables. Table 6 below shows the regression coefficients, the beta values of the regression, and the standard errors of each variable. According to the regression analysis the following variables, ranked by effect size using the β-coefficient, have a significant influence on the Attitude toward bio-based plastic products: *Trust* (β=0.302, $p < 0.001$), and *Green consumer values* (β=0.207, p=0.024). The variables *Previous product experience* (p=0.737), *Perceived consumer effectiveness* (p=0.857), and *Habit* (p=0.853) have no significant effect on Attitude toward bio-based plastic products. Due to this result, hypotheses H3a and H6a are supported while hypotheses H4a and H5a cannot be supported. Considering the results, it is particularly interesting that the effect size of the two significant

variables Trust and Green consumer values is nearly the same. The complete output of the multiple linear regression on Attitude is provided in Appendix F.

Table 6: Regression on attitude toward bio-based plastic products

Model: n=164, R^2=0.183, adjusted R^2= 0.157, F (5,158) = 7.071, p<0.001							
	B	SE	β	t	Sig	95% Confidence interval	
						Lower limit	Upper limit
(Constant)	3.559	0.542		6.561	<0.001***	2.487	4.630
Previous Experience	0.052	0.153	0.025	0.336	0.737	-0.251	0.354
Green Consumer Values	0.217	0.095	0.207	2.274	0.024*	0.029	0.406
Perceived Consumer Effectiveness	0.016	0.089	0.016	0.180	0.857	-0.159	0.191
Habit	-0.011	0.060	-0.013	-0.185	0.853	-0.130	0.108
Trust	0.219	0.055	0.302	3.960	<0.001***	0.110	0.328

Source: Own illustration

5.5. Additional Analyses: Mediational Role of Attitude

Lastly, a mediation analysis of Attitude on the relation of Green consumer values with Intention was performed. According to the literature, attitude is a mediator for the relationship between different variables, such as green consumer values and environmental knowledge, and intention to use green products (Asif et al., 2023; Moslehpour et al., 2023). Bio-based plastic is a kind of green product and as such it can be expected that Attitude also exists as a mediator within this context. In order to better understand the influence of Attitude on the pathways between Green consumer values and Perceived consumer effectiveness on the Intention to use bio-based plastic products, a mediation analysis was performed with PROCESS macro from Hayes (2022).

The objective of a mediation analysis is to establish a causal relationship and a time sequence between different variables. The analysis commences with the identification of a significant linear relationship (pathway c) between two variables, one of which is independent (X) and the other is dependent (Y). This relationship may be more complicated than a simple linear influence of X on Y and as such is investigated further. A mediator (M) may be influential and change the relationship between the original variables. This mediator is both significantly influenced by the independent variable X (pathway a), and itself significantly influences the dependent variable Y (pathway b). Following the introduction of the mediator, the linear and previously significant relationship between X and Y may either become completely insignificant, indicating complete mediation, of remain significant but with a reduced coefficient. This indicates that the previously direct effect has undergone a change in pathway through the mediator, resulting in the previously significant relationship between independent and dependent variable becoming non-significant. In the event that the effect is merely diminished but nevertheless significant, it is designated as partial mediation. The analysis is conducted by examining the total effect of the independent variable on the dependent variable, the effect of the independent variable on the mediator, the effect of the mediator on the independent variable, and lastly, the direct effect of the independent variable on the dependent variable (Baron & Kenny, 1986).

In order to perform a mediation analysis some prerequisites need to be fulfilled. The first condition is the linearity of the variables used in the analysis. The relationship between the variables for both Green consumer values and Perceived consumer effectiveness was approximately linear, as assessed by looking at the scatter plots of the variables after LOESS smoothing (Cleveland & Devlin, 1988). The remaining conditions presented in the literature have not been tested, as the bootstrapping method employed for the mediator analysis compensates for unfulfilled conditions. The other conditions are normally distributed residuals,

homoscedasticity, independence of the variables, and a timely presence of X before M as well as M before Y (Hayes, 2018, p. 68f).

The mediation analyses were performed with PROCESS macro by Hayes (2022) which uses ordinary least squares regression. The analysis was employed with bootstrapping with 5000 samples. In addition, heteroscedasticity consistent standard errors (Davidson & MacKinnon, 1993) were used to calculate the confidence intervals and inferential statistics. An effect was considered to be significant if the confidence interval did not include zero.

5.5.1. Independent Variable Green Consumer Values

A simple mediation analysis was performed to analyse whether Green consumer values predicts Intention to use bio-based plastic products and whether the path would be mediated by Attitude toward bio-based plastic products. An effect of B=0.6142, p<.001 was observed for the relationship between Green consumer values and Intention. After entering the mediator Attitude into the model, Green consumer values has a significant positive influence on the mediator, B=0.3459, p<.001. The mediator Attitude in turn significantly predicted Intention, B=0.3208, p<0.01. It was found after examining the relationship between Green consumer values and Intention to use bio-based plastic products that it is partially mediated by the attitude toward bio-based plastic products, indirect effect ab=0.1110, 95%-Confidence Interval [0.0470, 0.1890]. Figure 12 below shows the results of the analysis in a graphic illustration. The mediation analysis tables detailing the results of the mediation analysis are provided in Appendix G.

Figure 12: Mediation analysis (Independent variable Green Consumer Values)
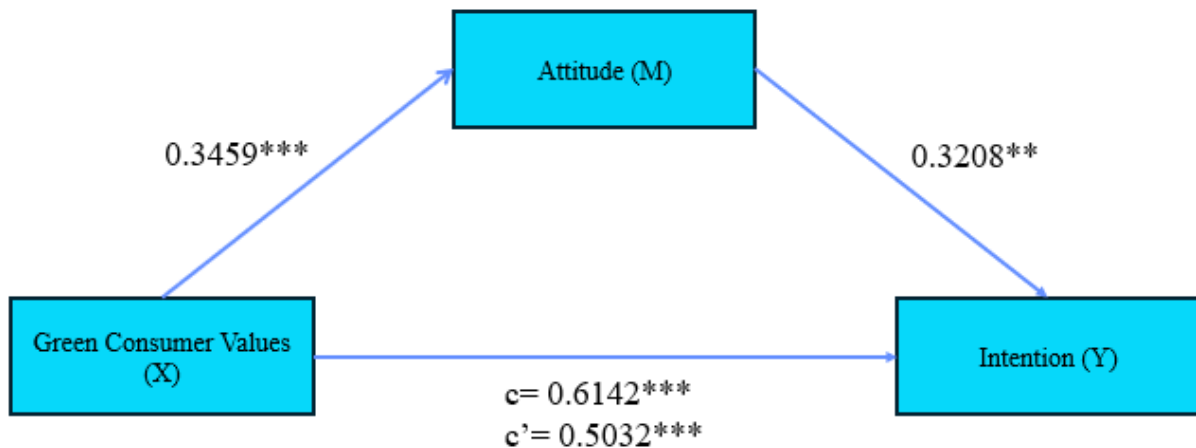
Source: Own illustration

5.5.2. Independent Variable Perceived Consumer Effectiveness

An additional simple mediation analysis was performed to analyse whether Perceived consumer effectiveness predicts Intention to use bio-based plastic products and whether this direct relationship is mediated by Attitude toward bio-based plastic products. A direct effect of Perceived consumer effectiveness on Intention was observed with B=0.4566, p<.001. After entering the mediator Attitude into the model, Perceived consumer effectiveness predicted the mediator significantly, B=0.2415, p<.01, which in turn has a significant positive influence on Intention, B=0.3838, p<.001. In the last step, the relationship between Perceived consumer effectiveness to Intention was found to be partially mediated by the introduction of Attitude, ab=0.0927, 95%-Significance Interval [0.0285, 0.1780]. Figure 13 presents the results of the analysis in a graphic illustration. The mediation analysis tables regarding Perceived consumer effectiveness are provided in Appendix H.

Figure 13: Mediation analysis (Independent variable Perceived Consumer Effectiveness)
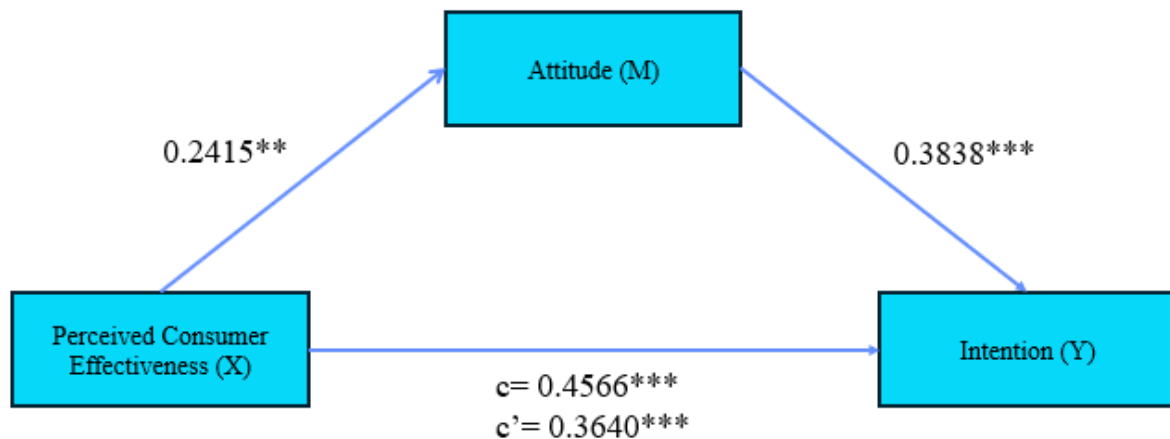

Source: Own illustration

5.6. Final Model

In order to provide an overview of the supported and rejected hypotheses, table 7 below was compiled based on the results of the preceding analyses. Additionally, the results were used to create the final research model to show the demonstrated influences. The effect sizes of the relationships are represented by the β-values.

Table 7: Summary hypotheses testing

H1 (+)	H1. A positive Attitude toward bio-based plastic products positively influences Intention to use bio-based plastic products.	Supported
H2 (+)	H2. High social pressure (Subjective norms) positively influences Intention to use bio-based plastic products.	Supported
H3a (+)	H3a. Green consumer values positively influence Attitude toward bio-based plastic products.	Supported
H3b (+)	H3b. Green consumer values positively influence Intention to use bio-based plastic products.	Supported
H4a (+)	H4a. Perceived consumer effectiveness positively influences Attitude toward bio-based plastic products.	Not supported
H4b (+)	H4b. Perceived consumer effectiveness positively influences Intention to use bio-based plastic products.	Supported

H5a (-)	H5a. Habit negatively influences Attitude toward bio-based plastic products.	Not supported
H5b (-)	H5b. Habit negatively influences Intention to use bio-based plastic products.	Not supported
H6a (+)	H6a. Trust positively influences Attitude toward bio-based plastic products.	Supported
H6b (+)	H6b. Trust positively influences Intention to use bio-based plastic products.	Not supported
H7a (-)	H7a. Cost perception negatively influences Intention to use bio-based plastic products.	Not supported
H7b (-)	H7b. Convenience perception negatively influences Intention to use bio-based plastic products.	Not tested

Figure 14: Final research model
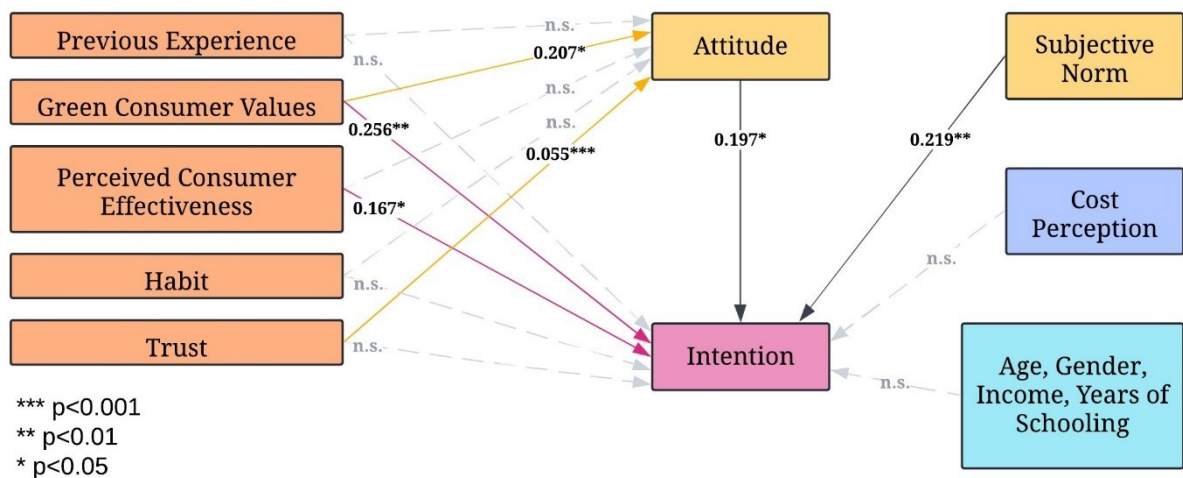
Source: Own illustration

6. Discussion

In the following, the results of the analyses are summarised and critically compared with previous literature on the subject which has been discussed in the literature review.

The overall aim of this master thesis was to assess the determinants in consumers' decision to use bio-based plastic products. Therefore, the objective of this research was first, to examine

the factors based on the TPB that influence the Intention to use bio-based plastic products by examining Attitude, Subjective norm, and Cost perception. Second, the study aimed to investigate how the TPB may be extended by four additional constructs that emerged from the literature review - Green consumer values, Perceived consumer effectiveness, Habit, and Trust – and analyse their influence on Attitude and Intention. Third, the research assessed whether Cost perception and Convenience perception can approximate perceived behavioural control within the model. In order to investigate these research objectives, two multiple linear regressions were conducted. In addition, to further investigate the role of Attitude, two mediation analyses of Attitude with two different independent variables were performed.

The analysis of the original framework of the TPB revealed that Attitude toward bio-based plastic products and Subjective norm had a significant impact on Intention to use bio-based plastic products, thereby supporting H1 and H2. Consequently, it can be concluded that the model of TPB can be applied for consumer behaviour in regard to usage of bio-based plastic products. However, the construct used for the approximation of perceived behavioural control, Perceived costs, showed no significant impact on the Intention to use bio-based plastic products, leading to the rejection of H7a. The other construct Perceived convenience could not be assessed as the items showed limited internal consistency. This result suggests that while Attitude and Subjective norm are significant drivers of Intention, Perceived costs seem to not be a primary concern for consumers when deciding on whether to use bio-based plastic products.

Within this study, the framework of TPB was extended by four additional constructs. The influence of each construct on Attitude and Intention was examined. Among these, Green consumer values and Trust were found to significantly influence Attitude toward bio-based plastic products, confirming hypotheses H3a and H6a. Hypothesis H4a regarding the influence of Perceived consumer effectiveness on Attitude was rejected. Moreover, it was found that

Green consumer values and Perceived consumer effectiveness were significant predictors of Intention, supporting H3b and H4b. On the other hand, Trust had no significant impact on Intention leading to the rejection of H6b. Furthermore, Habit was not significant for either Attitude or Intention, rejecting hypotheses H5a, and H5b.

The expected negative influence of Habit was found within this master thesis to have no significant influence on either Attitude or Intention. This contradicts previous studies such as Niedermeier et al. (2021) who found that habit is a significant inhibiting factor to the purchase of green consumer goods and Kumar Mishra et al. (2016) who argue that if people are strongly committed to brands they are less likely to try new products such as bio-based plastic. This finding could be a result of the limited availability of bio-based plastic products as they are not widely distributed yet (e.g., Dilkes-Hoffman et al., 2019), making it difficult for consumers to form habits around them. In addition, the sample of respondents leans towards a comparatively young age where Habits toward green products might not be as stabilised yet. Moreover, within the upper age range, Habits might be strongly formed leading to bio-based plastic products to not be assessed as viable product alternatives to conventional plastic products.

The extension of the TPB was analysed by investigating antecedents of Attitude toward bio-based plastic products. The analysis revealed that both Green consumer values (β=0.207) and Trust (β=0.055) have a significant positive effect on Attitude. When looking at the size of the coefficients, it is revealed that Green consumer values has a larger effect on Attitude than Trust. The influence of Geen consumer values confirms earlier research such as Rumm (2016) who demonstrated that people with higher environmental consciousness have a more positive attitude toward bio-based plastic products. Similarly, Scherer et al. (2017) found that consumers who are more environmentally aware are more interested in bio-based products and confirmed this in another study on bio-based sports equipment (Scherer et al., 2018b).

The positive influence of Trust on Attitude found in this analysis confirms that general Trust in green companies, and in eco-labels, increases the positive Attitude toward the product that they adhere to. This may be attributed to a generalised trust in the efficacy of eco-labelling, which may result in a reduction of the amount of credence qualities attributed to a product and an increase of the available information. This finding is consistent with the findings of Sijtsema et al. (2016) who discovered that the use of an eco-label to indicate the fully bio-based nature of a product led to an increase in trust in the claims made by the company, which in turn led to a more positive perception of the product. Moreover, Niedermeier et al. (2021) showed that trust in the form of trust in labels was an important factor in the perception of bio-based products.

Trust within this master thesis was not found to have a significant influence on Intention. This finding suggests that while Trust may enhance Attitude, it is insufficient on its own to drive Intention to use bio-based plastic products. This is in line with the findings of Rumm (2016) who demonstrated that while consumers expressed trust in labels on bio-based plastic products and thought that a label may help them in the buying process, these labels did not impact the decision-making process. The researcher explained this finding with the suggestion that the labels used in the study might confuse the participants because they come from an unknown institution as well as the unknown conditions under which the label is awarded. The findings of this study are in line with the results found in this master thesis. Trust is significant on Attitude toward bio-based plastic products, as it may help in the decision process, while it is not significant on Intention to use bio-based plastic products and thus indicates that a label by itself is not sufficient in the decision-process to adopt bio-based plastic products. This may be traced back to the lack of knowledge of certification on bio-based plastic products (Brécard, 2014; Moon et al., 2017; Morone et al., 2021), highlighting the necessity to actively promote a newly introduced label (Scherer et al., 2017).

After discussing the results of the regression on Attitude and the overall insignificant construct Habit, the next section evaluates the findings of the regression on Intention.

The non-significance of Previous product experience on Intention contrasts previous research which highlights the importance of previous experiences in shaping consumer intentions for green products (Blesin et al., 2017; Reinders et al., 2017), green apparel (Khare & Sadachar, 2017), and rain jackets made of bio-based plastic (Klein et al., 2020). In contrast, the findings of this master thesis support the argumentation of Ajzen (2002b) who argues that past behaviour does not significantly influence future behaviour. Thus, having used bio-based plastic before should not have an impact on future behaviour. Therefore, as behavioural intention is the best predictor of behaviour when a consumer has volitional control (Ajzen, 1991), the non-significance of Previous product experience on Intention supports this argumentation. Furthermore, in contrast to the relatively unknown material bio-based plastic and the subsequent assumption that Attitudes and Intentions may not be well-formed due to this lack of knowledge, the Attitudes and Intentions regarding bio-based plastic seem to be well-formed as no influence of Previous product experience was found on Intention within this master thesis. This is the case even though 68% of the total sample had no prior experience with bioplastics and as such could not turn this missing past experience into future usage intention.

When looking at the socio-demographic variables - Age, Gender, Income, and Years of schooling - none of them were found to have significant influence on Intention to use bio-based plastic products. In addition, this result was also found in the baseline model, where none of the demographic variables were significant. This aligns with previous research within the field of bio-based plastic showing no significant effect for age (Klein et al., 2019; Niedermeier et al., 2021; Scarpi et al., 2021; Scherer et al., 2018b), gender (Klein et al., 2019; Scherer et al., 2017, 2018b), education level (Klein et al., 2019; Testa et al., 2021), and income (Scherer et al., 2017). This leads to the conclusion that socio-demographic characteristics are not the distinguishing

factors between consumers who intend to use bio-based plastic products and those who do not. Instead, other factors are more important in the determination of the Intention to use bio-based plastic products. When assessing the factors that significantly influence Intention to use bio-based plastic products, which will be discussed in the next paragraphs, it can be concluded that the values of consumers regarding the environment, especially Green consumer values but also Perceived consumer effectiveness are more important than socio-demographic influences as they have significant effects on Intention in addition to Attitude and Subjective norm.

The regression analysis confirmed that the original TPB framework is relevant in explaining the Intention to use bio-based plastic products with Attitude and Subjective norm being significant predictors of Intention. However, the construct that should approximate perceived behavioural control, Perceived costs, did not significantly predict Intention. This indicates that cost is not the only inhibitor linked to perceived behavioural control that influences the respondents' Intention to use bio-based plastic products. In order to replace perceived behavioural control with Cost perception it was argued that bio-based plastic is a relatively unknown product type as could be concluded from the literature (e.g., Blesin et al., 2017; Dilkes-Hoffman et al., 2019; Sijtsema et al., 2016). Due to this, the most crucial factor impeding the use of bio-based plastic products would be cost which is the factor primarily visible within the stores. As costs in itself does not fit well with the belief system of the TPB, costs were approximated by Perceived costs as the inhibitor to consumers' Intentions to use bio-based plastic products. This argumentation thus could not be supported by the results of the analysis as Perceived costs have no significant effect on Intention. An explanation for this could be that a bio-based product needs to first, be present within the stores, second, be noticed, and third, convince the consumer that it is a viable product satisfying a need. As the analyses within this thesis have confirmed, Perceived knowledge and Previous product experience with bio-based plastic products are low. Furthermore, the distribution of products made of bio-based plastic is

limited (Plastics Europe AISBL, 2023; Rosenboom et al., 2022). The collective evidence suggests that consumers are unable to distinguish between bio-based plastic products and their conventional counterparts. Consequently, it is to be questioned whether they notice bio-based plastic products and beyond that the price differences. Thus, the increased prices of bio-based plastic products have minimal impact on Perceived costs, which in turn has a negligible effect on Intention to adopt them.

Subjective norm was found to be the second highest influence on Intention to adopt bio-based plastic products. This finding is in line with previous research which found subjective norm to be a significant influence regarding intention to buy green products (Yadav & Pathak, 2016), reduce usage of plastic bags (Sun et al., 2017), and visit green hotels (Chen & Tung, 2014; Teng et al., 2015). Gutiérrez-Taño et al. (2022) also found in their study that subjective norm significantly influenced intention to use bio-based plastic. This finding confirms the relative importance of the surrounding people on the evaluation of bio-based plastic. Their influence greatly impacts an individual's perception of bio-based plastic which could be a result of the previously mentioned low knowledge of the material and its characteristics. When people do not know something, they are more inclined to look towards others in their decision-making process. If the surrounding people suggest that using bio-based plastic is good for the environment or the individual person thinks that they suggest so respectively, then the individual person in turn experiences higher social pressure which is expressed in subjective norm. Thus, this process leads to higher intention to use bio-based plastic products.

The analysis of determinants of Intention with the additional constructs from the literature review on green products and bio-based plastic products provided further valuable insights. Of the additional constructs, Green consumer values and Perceived consumer effectiveness emerged as significant predictors of Intention to use bio-based plastic products. This is in line with the extensive previous research done on these two factors. The constructs demonstrate an

individual's perception of their relationship with the environment. Green consumer values describe the objective to protect the environment by one's purchases and consumption behaviours (Haws et al., 2014). The importance of green consumer values was demonstrated in previous research regarding bio-based functional clothing (Scherer et al., 2017), green products (Niedermeier et al., 2021), and the intention to purchase, pay, and switch to bioplastic products (Russo et al., 2019; Scarpi et al., 2021). Furthermore, perceived consumer effectiveness expresses the extent to which a person believes their own individual actions can help in the protection of the environment (Scherer et al., 2018b). The findings of this master thesis regarding this construct are in line with previous research demonstrating that perceived consumer effectiveness is an important factor determining green behaviour (Asif et al., 2023; Roberts, 1996). Taken together, the results express that while green consumer values are important to perform green behaviour, in this case, purchase bio-based plastic products instead of conventional plastic products, consumers also need to feel that they are able to change something by their purchasing behaviour. Notably, the effect size of Green consumer values ($\beta=0.256$) on Intention was found to be larger in comparison to the original constructs of TPB, Attitude ($\beta=0.197$) and Subjective norm ($\beta=0.219$). Moreover, Perceived consumer effectiveness also represents a significant, albeit smaller, impact on Intention ($\beta=0.167$). This leads to the conclusion that these two concepts can be used to extend the TPB as they explain a larger part of the variance of Intention to adopt bio-based plastic products than the original concepts. Green consumer values thus have both a direct effect on Intention and an indirect effect by positively influencing Attitude toward bio-based plastic which in turn positively impacts Intention. Therefore, it can be demonstrated that Green consumer values play a pivotal role in driving the Intention to use bio-based plastic products alongside the original constructs of TPB. The importance of Green consumer values in this master thesis serves to prove that this is a valuable concept to add to the TPB, improving the general predictive validity of the model.

Therefore, it can be deducted that values regarding the environment shape a consumers' attitude and intention to use bio-based plastic products, and thus influence the formation of beliefs preceding the attitude toward bio-based plastic products (Ajzen, 1991).

In regard to the decision to use bio-based plastic products, it needs to be kept in mind that while the intention to use such a material is present and was demonstrated within this study, it does not necessarily mean that such an intention is turned into actual behaviour. As with other green consumption behaviours, an intention-behaviour gap may exist where respondents express an intention to perform a behaviour but do not perform it. This has been demonstrated to be due to a differing influence of perceived convenience on a behaviour decision between green and non-green consumers (Barbarossa & De Pelsmacker, 2016). The influence of Perceived convenience as a determining factor of Intention could not be assessed within this master thesis as the internal consistency of the construct was not adequate. Therefore, it may be assumed that this phenomenon might also be present within this master thesis as its existence has been demonstrated within the bio-based plastic field before (Ruf et al., 2022). The difference between intention to adopt bio-based plastic products and the assumed presence of an intention-behaviour gap complicates the prediction of bio-based plastic product adoption with the TPB.

To further investigate the role of Attitude, two mediation analyses were performed with Intention as the dependent variable. For both mediation analyses, with Green consumer values and with Perceived consumer effectiveness as independent variables, a partial mediation was observed. This further confirms the idea that while Green consumer values directly influence Intention, their indirect influence via Attitude also represent an important impact on Intention to use bio-based plastic products. This confirms previous research on attitude as a mediator for green products with the independent variables of green consumer values and environmental knowledge by Asif et al. (2023) and Moslehpour et al. (2023). In addition, Vermeir and Verbeke (2006) showed that attitude was a mediator on intention to buy sustainable dairy with the

independent variable perceived consumer effectiveness. The mediation analyses of this master thesis confirm that Attitude is a mediator for Green consumer values and Perceived consumer effectiveness on Intention to use bio-based plastic products.

The findings of this master thesis led to the conclusion that Green consumer values are particularly important in determining the Intention of consumers to adopt bio-based plastic. This suggests that a first distribution of bio-based plastic products will be primarily among consumers that have green consumer values and feel like bio-based plastic products may help alleviate problems of the environment and plastic production. Promotion of bio-based plastic products can thus be best achieved by appealing to the green consumer values of individual consumers. The combination of green consumer values with the perception that individuals can exert influence on environmental protection and undertake individual efforts to that end (perceived consumer effectiveness) leads to a higher intention toward using bio-based plastic products. Consequently, as intention is the best predictor of actual behaviour in presence of volitional control, according to Ajzen (1991), it can be assumed that the intention to use bio-based plastic products is transformed into actual adoption of these products.

7. Managerial Implications

In light of the findings presented in this master thesis, a number of managerial implications can be derived, which will be discussed in the following chapter.

First, given the importance of Green consumer values found within this study which impact both Attitudes and Intentions, managers should focus on highlighting the known environmental advantages of bio-based plastic products in marketing strategies and communication. The focus on the environmental advantages of this material may both increase individual consumer knowledge and attract additional consumers. Moreover, consumers with high green consumer values will be attracted by the addressing of specific information on the product's sustainability.

Additionally, the employment of more trustworthy information on the advantages of bio-based plastic compared to fossil-based plastic will increase the evaluation of such products as being a way of expressing green purchasing behaviour. As consumers with high green consumer values are inclined to express their values via their purchase decisions due to their intrinsic desire to be environmentally conscious, additional information regarding the environmental impact can attract them towards purchasing bio-based plastic products while appealing to their emotions within marketing campaigns may increase their positive sentiments and attitudes towards the products.

Second, in the analyses of this research, Trust was found to positively influence attitude toward bio-based products. The question items that evaluated Trust are in part based on the employment of an eco-label to validate claims and information given on the bio-based product. Thus, the application of credible third-party eco-labels regarding bio-based materials while also providing information about them to consumers may positively shape consumers' attitudes toward bio-based plastic products. Importantly, these labels need to be from trustworthy independent agencies, and should be simple as well as easy to understand in order to alleviate the effort consumers need to employ to assess the labels (Herbes, 2021). Some labels of this kind already exist and are used within the market. In the following, a selection of these labels and standards are shortly presented. One such label specifically regarding bio-based plastic products is the "OK biobased" certification of TÜV Austria. The evaluation assesses the proportion of renewable raw materials incorporated into the bio-based product, conferring a rating based on the percentage of renewable content, with a minimum threshold of 20% for the inclusion of renewable raw materials (TÜV Austria). This label is based on the European Committee for Standardisation (CEN) standard "CEN/TS 16137:2011 Plastics – Determination of biobased carbon content". The standard prescribes a calculation method to determine the bio-based carbon content within monomers, polymers, plastic materials, and plastic products.

Currently, the EU develops a new standard which is set to include sustainability assessment criteria for bio-based products (European Bioplastics e.V.). A third standard certifying bio-based products is the U.S. Department of Agriculture' "BioPreferred Program". It provides useful information to consumers about the bio-based nature of products, including bio-resins, biopolymers, or biobased chemicals. The label attests to the fact that the USDA verified the amount of renewable biological ingredients and that the product meets a minimum bio-based content set by the USDA (U.S. Department of Agriculture, 2016).

Third, Perceived consumer effectiveness had a significant positive influence on intention to use bio-based plastic products. Therefore, companies should educate consumers on the ways that their own sustainable purchase behaviour can contribute to environmental protection while also detailing how their actions can help improve sustainability efforts. When consumers feel that their behaviour and choices matter, they are more inclined to act in ways that align their choices to their values, which in this case are the green consumer values. This can be achieved by clearly communicating the environmental benefits that the individual's choice of bio-based plastic products has over conventional plastic products in marketing campaigns and thus empowering the consumer on the pathway to act more sustainably. A way of increasing perceived consumer effectiveness is providing verifiable data on the impact of individual decisions on mitigating the adverse effects of plastic and plastic production. Moreover, addressing a consumer as part of a group in a marketing campaign can also increase perceived consumer effectiveness because a group can achieve more than an individual person. By integrating the individual effectively into the group and them internalising the group's values for example by an effective marketing campaign, the perceived consumer effectiveness of the individual can be increased. This leads to increased intention to use a bio-based plastic product and thus may lead to the actual adoption of such a product.

Fourth, the analysis demonstrated that Subjective norm had a significant impact on Intention to use bio-based plastic products, being the second highest predictor overall. Subjective norm expresses the extent to which an individual feels that other important people to them or people knowledgeable of the subject want them to act. Thus, subjective norm can be leveraged by showcasing endorsements from influencers, testimonials from satisfied customers, or partnerships with environmental organisations. This results in individuals being persuaded that prominent figures to them endorse the product, which in turn increases their experienced social pressure, expressed by subjective norm, and alters their behavioural intention, potentially leading to a shift in their own behaviour from conventional plastic products to the utilisation of bio-based plastic products.

Fifth, as has been shown within this study as well as most of the previous research, product awareness and knowledge are low and may be hindering adoption of bio-based plastic. To effect this change, companies engaged in the production of bio-based plastic products should focus on enhancing product visibility and consumer education. This may be achieved through strategies such as product sampling, the deployment of trained personnel in market settings, the implementation of incentives to encourage initial purchases, or the utilisation of influencers to illustrate the tangible benefits associated with the bio-based plastic product.

Sixth, more companies using plastic in their products should seek out how to exchange their fossil-based material with more sustainable materials, i.e. bio-based plastic. To achieve this, extensive research and development need to be deployed. Currently, most of the bio-based plastic is made of first-generation biomass leading to problems regarding agricultural farming (Rosenboom et al., 2022). In order to achieve more sustainable and environmentally friendly bio-based plastic material, research should be conducted on how second-generation biomass such as biowaste can be used to generate plastic. This requires significant economic investments along with the development of specific expertise within the field of bio-based plastic. Moreover,

further research is required on the environmental impact of bio-based plastic, employing the methodology of LCA. When LCAs are conducted thoroughly and according to rigorous standards it becomes possible to gain a deeper understanding of the circumstances under which bio-based plastics can be seen to offer advantages over conventional fossil-based materials, and to identify ways in which these advantages can be exploited. The development of bio-based plastics with greater sustainability is a crucial objective for producers of bio-based plastic products, given that, at present with current production methods, there is no definitive evidence that bio-based plastics are more sustainable than their conventional counterpart. In order to effectively engage with consumers who espouse higher green consumer values, it is imperative that bio-based plastic products are demonstrated to be more environmentally friendly than fossil-based plastic products.

Seventh, the findings of this master thesis can also be used by regulators to promote the adoption of bio-based plastic products. Regulators can introduce strategies and communications that encourage the usage of bio-based plastic products in place of conventional plastic products by leveraging the importance of Green consumer values, Perceived consumer effectiveness, and Trust. A similar approach to that employed by companies could be adopted, with the aim of appealing to consumers' emotions and values regarding the importance of environmental protection. The efficacy of this approach can be enhanced by illustrating ways in which each consumer can contribute to the reduction of the environmental impact of plastic through the utilisation of bio-based plastic products. Lastly, regulators can work to increase trust in bio-based plastic products by introducing third-party eco-labels and standards for the establishment of company-issued eco-labels for bio-based plastic as described above.

8. Limitations & Future Research Opportunities

After discussing the results of this master thesis and their managerial implications, this section evaluates the limitations this master thesis experiences and expresses suggestions for further research.

First, due to convenience-sampling and the non-representative response sample, the results cannot be generalised to the greater population. Moreover, the survey was distributed online through social media networks resulting in a sample of respondents who were only those with internet access and the ability to utilise these platforms. In order to generalise the results, more research with representative sample sizes and distributions should be employed in the future.

Second, the sample size of respondents of this master thesis is limited, which may compromise the reliability of the analysis as the data might be more susceptible to the influence of outliers or extreme values. Moreover, fewer respondents may reduce the generalisability of the results to a larger population as well as an inaccuracy in effect sizes.

Third, this master thesis only looked at the Intention to use bio-based plastic products instead of actual behaviour. Ajzen (1991) argues that intention to perform a behaviour is a person's most immediate determinant of that behaviour if the behaviour is under volitional control. In contrast to this, research often has discovered a so-called intention-behaviour gap, which describes the phenomenon in green literature that while green consumers often intend to perform a green behaviour and report on this, they do not actually perform the behaviour (Barbarossa & De Pelsmacker, 2016). Ruf et al. (2022) concluded that the difference between consumer intention to buy bio-based plastic products and their actual market share in the total plastic market might be due to the existence of such an intention-behaviour gap in the matter of bio-based plastic. Further research should include experimental study designs in order to

evaluate whether intention to use bio-based plastic products actually is translated into behaviour or if the intention-behaviour gap is also relevant within this context.

Fourth, this thesis has demonstrated that Cost perception did not have significant effects on Intention to use bio-based plastic products. Further research should investigate the role of perceived behavioural control and the inhibiting influences that distinct aspects, such as costs and convenience, have on intention to use bio-based plastic products and actual behaviour.

Fifth, as was demonstrated within this thesis, three additional constructs -Green consumer values, Perceived consumer effectiveness, and Trust- could be used to extend the TPB. Further research should investigate these relationships more in detail and quantify them regarding specific bio-based plastic products. Additionally, other constructs should be assessed on their influence on intention and attitude, such as health-related factors or cultural factors.

9. Conclusion

This master thesis contributes to the investigation and understanding of factors influencing the decision to use or adopt bio-based plastic products by consumers. In order to achieve this, it aimed at examining the factors that influence intention to use bio-based plastic products within the framework of TPB by examining attitude, subjective norm, and cost perception. Secondly, the study was investigating how the TPB can be extended by four additional constructs which emerged from the literature review, Green consumer values, Perceived consumer effectiveness, Habit, and Trust, and to analyse their influences on Attitude and Intention.

To achieve this, first the term and material bio-based plastic was classified in distinction to other similar materials. Moreover, the theoretical framework TPB was studied extensively. Subsequently, a literature review was conducted in order to assess different influences consumers experience on attitude toward and intention to use bio-based plastic products in addition to possible extensions of the TPB.

Based on the literature review, several factors could be found that further influence the attitude toward and intention to use bio-based plastic products. In order to investigate these factors two multiple linear regressions and two mediation analyses were performed.

The analysis confirmed that the framework of TPB can also be applied to evaluate consumer behaviour in regard to bio-based plastic products. The TPB components Attitude and Subjective norm were found to be significant drivers of Intention. In addition, when extending the TPB, Green consumer values and Trust were found to significantly influence Attitude. Both Previous product experience and Habit had no significant effects on either Attitude or Intention.

When assessing influences on Intention, Cost perception and all socio-demographic factors had no significant influence. In contrast, Green consumer values and Perceived consumer effectiveness were found to positively influence Intention alongside Attitude and Subjective norm. Green consumer values was the most important influence on Intention, followed by Subjective norm, Attitude, and lastly, Perceived consumer effectiveness. When further investigating Attitude as a mediator, it was found that Green consumer values and Perceived consumer effectiveness both had a direct effect on Intention and an indirect effect via Attitude as a mediator. This provides further evidence that Attitude can be considered a partial mediator in an extended TPB, and that it is a factor that can be evaluated in greater depth in subsequent research on bio-based plastic products.

The findings of this master thesis can inform bio-based plastic product producers on the development of more effective strategies to engage with their potential customers and select appropriate marketing campaigns and communication methods. As this master thesis has demonstrated, consumers generally hold a positive attitude towards bio-based plastic products. The findings of this study substantiate the hypothesis that people with Green consumer values are also inclined to utilise such materials, either directly, as well as indirectly through the more positive Attitude towards bio-based plastic products. Therefore, if the objective of bio-based

plastic product producers and regulators is to facilitate the uptake of bio-based plastic product adoption, it is essential to cultivate a more favourable attitude among consumers by appealing to their intrinsic desire to be environmentally conscious. This can be achieved by evoking emotions and instilling a sense of empowerment in individuals, thereby encouraging them to recognise the potential of their actions in mitigating the adverse effects of plastic.

Furthermore, the results can be used as a basis to increase efforts for a trustworthy third-party eco-label in order to increase consumer recognition of bio-based materials. By investing in the awarding of such an eco-label and taking the necessary steps in fulfilling the conditions associated with such an eco-label, companies actively invest in a trust signal. Therefore, consumers are more inclined to trust in the claims of the companies who were awarded an eco-label regarding bio-based plastic products. This can positively influence consumers' Attitude toward bio-based plastic products.

In conclusion to this thesis, the findings collectively substantiate the hypothesis that consumers are interested in the adoption of bio-based plastic products and intend to adopt them when presented with the opportunity to do so. This is particularly the case for consumers who are interested in environmental protection and who perceive that they can make a difference on an individual level. Bio-based plastic product producers need to improve the sustainability of their products to the end that bio-based plastic products are under all circumstances more environmentally-friendly than conventional plastic products. One promising pathway is the usage of second-generation feedstock to produce the bio-based plastic material, mitigating the problem of increasing food waste and limiting specific production of first-generation feedstock for bio-based plastics. The combination of an increase in the production of bio-based plastic products and an improvement in the environmental friendliness of the material may help to alleviate some of the problems caused by plastic and plastic production. Furthermore, the utilisation of bio-based plastic and its second-generation feedstock, in conjunction with the

appropriate recycling or, in certain instances, composting, contributes to the advancement of a more efficient circular economy.

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Image Sources

Image 1: Lego (2024). *Working towards sustainable LEGO® bricks and elements*. Retrieved 08.09.2024 from https://www.lego.com/en-gb/sustainability/sustainable-materials

Image 2: BASF (2024). *Soil-biodegradable ecovio® for mulch films: better soil, higher yield and no persistent microplastic*. Retrieved 08.09.2024 from https://plastics-rubber.basf.com/emea/en/performance_polymers/products/ecovio/ecovio_mulch_film

Image 3: Vaude (2024). *Trail Spacer 28 – Lightweight backpack*. Retrieved 08.09.2024 from https://www.vaude.com/de/en/14569-trail-spacer-28-lightweight-backpack.html#?colour=2032&size=13424

Appendices

Appendix A: Complete Questionnaire

soSci
oFb - der onlineFragebogen

TC02

Survey: Consumer Opinions on Bio-based Plastic Products

This survey is part of a master thesis at the University of Pavia and University of Tübingen and aims at gathering opinions on bio-based plastic products. Your participation in this survey is voluntary and will take approximately 10 minutes. Your responses will be confidential and only used in the context of this research. The collected answers will not be connected to you in any way whatsoever.

Proceeding to the survey implies that you understand and agree to the TC01 **provisions in this disclaimer.**

○　I agree and proceed to the survey.

1. Question<div align="right">PE03</div>

Bio-based Plastic

The 'normal' plastic that you know from your everyday life is made from fossil feedstocks such as petroleum and natural gas.

The defining feature of 'bio-based' plastic is that it is made entirely (or partially) from 'biomass'. Biomass used for bio-based plastics stems from e.g., corn, sugarcane, or wood. As such they can contribute to the more sustainable management of food waste and reduce the use of the non-renewable resource petroleum for plastic production. On the other hand, live-cycle assessment of bio-based plastics' environmental footprint considers them to not always being better than traditional plastic and there might be problems arising due to competition on land use with food production.

Bio-based plastic is often very similar in appearance to conventional 'normal' plastic and can be shaped and used for a great variety of products, including bottles, utensils, toys, shopping bags, packaging materials, clothes, and many other everyday items.

2. Have you ever heard of bio-based plastic?<div align="right">PE01</div>

Please select the answer most applicable to you.

○ Yes, I have heard of bioplastics before and I know exactly what that is.

○ Yes, I have heard of it before.

○ No, I have never heard of it.

3. Have you ever deliberately opted for bioplastics?<div align="right">PE02</div>

Please select the answer most applicable to you.

○ Yes

○ No

<div align="right">RA02</div>

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4. To what extent do you agree with these statements?

Please rate your answer on the scale between I completely disagree and I completely agree.

	Completely disagree						Completely agree
I have a favourable attitude towards purchasing a bio-based version of a product.	○	○	○	○	○	○	○
I like the idea of purchasing bio-based plastic products.	○	○	○	○	○	○	○
Purchasing bio-based plastic products is a good idea.	○	○	○	○	○	○	○

Within this section, I would like you to reflect on the influences on your decision to buy bio-based plastic products. `BC03`

5. To what extent do you agree with these statements? `RA03`

Please rate your answer on the scale between I completely disagree and I completely agree.

	Completely disagree						Completely agree
The majority of the people who are important to me think that we should use bioplastics.	○	○	○	○	○	○	○
The people close to me (partner, children, parents, and friends) would use bioplastics instead of petroleum-based plastic.	○	○	○	○	○	○	○
Society, in general, thinks that we should use bioplastics.	○	○	○	○	○	○	○
The majority of the people whose opinions I value prefer to use bioplastics.	○	○	○	○	○	○	○

`BC01`

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6. To what extent do you agree with these statements?

Please rate your answer on the scale between I completely disagree and I completely agree.

	Completely disagree						Completely agree
If the cost of a bio-based plastic jacket was the same as the cost of a conventional jacket, I would be more likely to buy the bioplastic one.	○	○	○	○	○	○	○
I am willing to pay a higher price for the bio-based plastic product.	○	○	○	○	○	○	○
I can afford to buy bio-based plastic products.	○	○	○	○	○	○	○

7. To what extent do you agree with these statements?

BC02

Please rate your answer on the scale between I completely disagree and I completely agree.

	Completely disagree						Completely agree
Bio-based plastic products are only available in limited stores/ markets.	○	○	○	○	○	○	○
The stores that I frequently shop at do not sell bio-based plastic products.	○	○	○	○	○	○	○
Buying bio-based plastic products is highly inconvenient.	○	○	○	○	○	○	○

In this section, I would like to know more of your concern about the environment. `EC03`

8. To what extent do you agree with these statements? `EC01`

Please rate your answer on the scale between I completely disagree and I completely agree.

	Completely disagree						Completely agree
It is important to me that the products that I use do not damage the environment.	○	○	○	○	○	○	○
I would describe myself as environmentally responsible.	○	○	○	○	○	○	○
My buying habits are affected by my concerns for the environment.	○	○	○	○	○	○	○
I worry about wasting our planet's resources.	○	○	○	○	○	○	○
I am willing to experience discomfort to take more respectful measures concerning the environment.	○	○	○	○	○	○	○
I take into account the impact that my consumer behaviour has on the environment.	○	○	○	○	○	○	○

`EC02`

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9. To what extent do you agree with these statements?

Please rate your answer on the scale between I completely disagree and I completely agree.

	Completely disagree						Completely agree
Each consumer's behaviour may have a positive effect on society, provided they purchase products sold by socially responsible companies.	○	○	○	○	○	○	○
Since a lone individual cannot have any effect on pollution or the over-exploitation of natural resources, it doesn't make a difference what I do.	○	○	○	○	○	○	○
Whenever I buy products, I try to consider how my use of them will affect the environment and other consumers.	○	○	○	○	○	○	○
It is worthless for the individual consumer to do anything about pollution.	○	○	○	○	○	○	○

RA01

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10. To what extent do you agree with these statements?

Please rate your answer on the scale between I completely disagree and I completely agree.

	Completely disagree					Completely agree
In the future, when I have to choose between a product made from conventional materials and one made from renewable raw materials, I will choose the one that is made from renewable raw materials.	○	○	○	○	○	○
I will look for and try to use/ choose bio-based plastics in my future shopping behaviour.	○	○	○	○	○	○
I will conscientiously take into account bio-based plastic products made from renewable resources when making buying decisions in the future.	○	○	○	○	○	○

Within this section, please, indicate some of your consumer characteristics. [CC03]

11. To what extent do you agree with these statements? [CC01]

Please rate your answer on the scale between I completely disagree and I completely agree.

	Completely disagree						Completely agree
I go to the same store each time I shop.	○	○	○	○	○	○	○
I have favourite brands I buy over and over.	○	○	○	○	○	○	○
I change brands regularly.	○	○	○	○	○	○	○
Once I find a product or brand I like, I stick with it.	○	○	○	○	○	○	○

[CC02]

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12. To what extent do you agree with these statements?

Please rate your answer on the scale between I completely disagree and I completely agree.

	Completely disagree						Completely agree
I trust that those selling or producing bio-based products are honest about the bio-based nature of their products.	○	○	○	○	○	○	○
I trust eco-certification and eco-labels.	○	○	○	○	○	○	○
I trust that eco-friendly companies comply with environmental standards.	○	○	○	○	○	○	○
I trust information on eco-labels.	○	○	○	○	○	○	○

SQ07

You are nearly done with the survey!
To conclude, I would like to know some of your demographic data for statistical purposes.

13. What is your age?

SQ01

○ 16-19
○ 20-29
○ 30-39
○ 40-49
○ 50-59
○ >60

○ Prefer not to answer

14. To which gender do you most identify?

SQ02

○ Male
○ Female
○ Other

○ Prefer not to answer

SQ03

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15. What is the highest degree or level of school you have completed? If you are currently enrolled in school, please indicate the highest degree you have received.

○ Elementary/ Middle School Degree

○ High School Degree

○ Bachelor Degree

○ Master Degree

────────────────────────────────

○ Prefer not to answer

16. What is your households' monthly income? `SQ04`

○ No income

○ under 500 €

○ 500 € to under 1,000 €

○ 1,000 € to under 1,500 €

○ 1,500 € to under 2,000 €

○ 2,000 € to under 2,500 €

○ 2,500 € to under 3,000 €

○ 3,000 € and more

────────────────────────────────

○ Prefer not to answer

17. Please indicate the country where you have lived for most of your life. `SQ05`

Country [＿＿＿＿＿＿＿＿＿＿＿＿]　　☐ Prefer not to answer

`SQ06`

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18. Please indicate the country of your residence.

Country   [   ]   ☐ Prefer not to answer

Last Page

Thank you for completing this questionnaire!

I would like to thank you very much for helping me.

Your answers were transmitted, you may close the browser window or tab now.

For further information or any remarks please contact the author under the following email adress: nataliemarie.musik01@universitadipavia.it

B. Sc. Natalie Musik, Universität Tübingen Università di Pavia – 2024

Appendix B: Variable Overview

Variable	Items	Source	Scale
Attitude	I like the idea of purchasing bio-based plastic products.	Taylor and Todd (1995)	7-point Likert scale from completely disagree to completely agree
	Purchasing bio-based plastic products is a good idea.		
	I have a favourable attitude towards purchasing a bio-based version of a product.		
Subjective Norm	The people close to me (partner, children, parents, and friends) would use bioplastics instead of petroleum-based plastic.	Gutiérrez-Taño et al. (2022)	7-point Likert scale from completely disagree to completely agree
	The majority of the people whose opinions I value prefer to use bioplastics.		
	The majority of the people who are important to me think that we should use bioplastics.		
	Society, in general, thinks that we should use bioplastics.		
Cost Perception	I can afford to buy bioplastic products.	Notaro et al. (2022)	7-point Likert scale from completely disagree to completely agree
	I am willing to pay a higher price for the bioplastic product.		
	If the cost of a bioplastic jacket was the same as the cost of a conventional jacket, I would be more likely to buy the bioplastic one.		

Convenience Perception	Buying bio-based plastic products is highly inconvenient.	Niedermeier et al. (2021)	7-point Likert scale from completely disagree to completely agree
	Bio-based plastic products are only available in limited stores/ markets.		
	The stores that I frequently shop at do not sell bio-based products.		
Intention	I will conscientiously take into account bioplastic products made from renewable resources when making buying decisions in the future.	Gutiérrez-Taño et al. (2022)	7-point Likert scale from completely disagree to completely agree
	In the future, when I have to choose between a product made from conventional materials and one made from renewable raw materials, I will choose the one that is made from renewable raw materials.		
	I will look for and try to use/ choose bioplastics in my future shopping behaviour.		
Previous Experience	Have you ever deliberately opted for bioplastics?	Klein et al. (2019)	Yes; No

Perceived Knowledge	I would like to know if you ever heard of bioplastics?	Klein et al. (2019)	Yes, I have heard of bioplastics before and I know exactly what that is; Yes, I have heard of it before; No, I have never heard of it
Green Consumer Values	It is important to me that the products that I use do not damage the environment.	Gutiérrez-Taño et al. (2022)	7-point Likert scale from completely disagree to completely agree
	I take into account the impact that my consumer behaviour has on the environment.		
	My buying habits are affected by my concerns for the environment.		
	I worry about wasting our planet's resources.		
	I would describe myself as environmentally responsible.		
	I am willing to experience discomfort to take more respectful measures concerning the environment.		

Perceived Consumer Effectiveness	It is worthless for the individual consumer to do anything about pollution.	Niedermeier et al. (2021)	7-point Likert scale from completely disagree to completely agree
	Whenever I buy products, I try to consider how my use of them will affect the environment and other consumers.		
	Since a lone individual cannot have any effect on pollution or the over-exploitation of natural resources, it doesn't make a difference what I do.		
	Each consumer's behaviour may have a positive effect on society, provided they purchase products sold by socially responsible companies.		
Habit	I have favourite brands I buy over and over.	Niedermeier et al. (2021)	7-point Likert scale from completely disagree to completely agree
	Once I find a product or brand I like, I stick with it.		
	I go to the same store each time I shop.		
	I change brands regularly.		

Trust	I trust that those selling or producing bio-based products are honest about the bio-based nature of their products.	Niedermeier et al. (2021)	7-point Likert scale from completely disagree to completely agree
	I trust that eco-friendly companies comply with environmental standards.		
	I trust eco-certification and eco-labels.		
	I trust information on eco-labels.		

Appendix C: Tables of Sociodemographic Data

Table 8: Demographic data

		Numer of Cases	Percentage
Gender	Not answered	25	13,6%
	Male	55	29,9%
	Female	104	56,5%
Age	Not answered	21	11,4%
	16-19	4	2,2%
	20-29	106	57,6%
	30-39	10	5,4%
	40-49	9	4,9%
	50-59	13	7,1%
	>60	21	11,4%
Schooling Level	Not answered	23	12,5%
	Elementary/ Middle School	5	2,7%
	Highschool	35	19,0%
	Bachelor Degree	69	37,5%
	Master Degree	52	28,3%
Monthly Household Income	Not answered	51	27,7%
	No income	14	7,6%
	under 500€	2	1,1%
	500€ to under 1,000€	35	19,0%
	1,000€ to under 1,500€	16	8,7%
	1,500€ to under 2,000€	10	5,4%
	2,000€ to under 2,500€	7	3,8%
	2,500€ to under 3,000€	11	6,0%
	3,000€ and more	38	20,7%

Table 9: Origin & longest residency of respondents

Country	Longest Lived In	Country of Origin
Albania	1	0
Austria	1	1
Belgium	2	3
Denmark	1	0
Egypt	1	0
Finland	2	2
France	2	2
Germany	118	108
Honduras	1	0
India	1	0
Indonesia	1	0
Israel	1	0
Italia	10	26
Jordan	1	0
Lebanon	1	0
Netherlands	0	1
New Zealand	0	1
Pakistan	2	0
Poland	2	1
Switzerland	4	8
Türkiye	1	0
United Kingdom	2	1
United States	2	3
Uruguay	0	1
Vietnam	1	0
Not answered	29	29

Appendix D: Baseline Model Regression on Intention

Table 10: Regression table baseline model on intention

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,225[a]	,050	,021	1,01648	1,824

a. Predictors: (Constant), Income, Experience, Gender, Schooling_Years, Age

b. Dependent Variable: Intention

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8,831	5	1,766	1,709	,135[b]
	Residual	166,349	161	1,033		
	Total	175,180	166			

a. Dependent Variable: Intention

b. Predictors: (Constant), Income, Experience, Gender, Schooling_Years, Age

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	5,251	,348		15,104	<,001	4,564	5,937		
	Experience	,290	,171	,134	1,693	,092	-,048	,629	,936	1,069
	Age	,011	,006	,179	2,029	,044	,000	,023	,757	1,321
	Gender	,101	,142	,057	,712	,477	-,179	,381	,905	1,105
	Schooling_Years	-,027	,024	-,094	-1,117	,266	-,074	,020	,827	1,210
	Income	1,828E-5	,000	,023	,254	,800	,000	,000	,745	1,343

a. Dependent Variable: Intention

Appendix E: Multiple Linear Regression Intention

Table 11: Regression table on intention

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,705[a]	,497	,457	,75325	1,917

a. Predictors: (Constant), Income, Trust, Gender, Experience, Habit, Norm, Effectiveness, Schooling_Years, Age, Cost, Green Values, Attitude

b. Dependent Variable: Intention

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	84,517	12	7,043	12,413	,000[b]
	Residual	85,670	151	,567		
	Total	170,186	163			

a. Dependent Variable: Intention

b. Predictors: (Constant), Income, Trust, Gender, Experience, Habit, Norm, Effectiveness, Schooling_Years, Age, Cost, Green Values, Attitude

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	Upper Bound	Collinearity Statistics Tolerance	VIF
1	(Constant)	-,103	,584		-,176	,860	-1,256	1,050		
	Cost	,060	,080	,062	,746	,457	-,099	,218	,479	2,086
	Habit	,013	,052	,015	,243	,809	-,090	,116	,898	1,114
	Trust	,089	,052	,119	1,720	,088	-,013	,191	,699	1,431
	Green Values	,278	,086	,256	3,225	,002	,108	,448	,528	1,894
	Effectiveness	,173	,078	,167	2,226	,028	,019	,327	,594	1,684
	Experience	,083	,132	,038	,626	,532	-,178	,344	,889	1,125
	Attitude	,204	,083	,197	2,445	,016	,039	,368	,513	1,948
	Norm	,206	,067	,219	3,067	,003	,073	,339	,652	1,535
	Age	,002	,004	,033	,480	,632	-,007	,011	,722	1,386
	Gender	,007	,113	,004	,059	,953	-,217	,230	,901	1,110
	Schooling_Years	,000	,022	,001	,012	,990	-,044	,044	,759	1,318
	Income	-2,237E-5	,000	-,028	-,408	,684	,000	,000	,721	1,388

a. Dependent Variable: Intention

Appendix F: Multiple Linear Regression Attitude

Table 12: Regression table on attitude

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,428[a]	,183	,157	,90802	2,243

a. Predictors: (Constant), Experience, Effectiveness, Habit, Trust, Green Values

b. Dependent Variable: Attitude

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	29,149	5	5,830	7,071	<,001[b]
	Residual	130,271	158	,824		
	Total	159,420	163			

a. Dependent Variable: Attitude

b. Predictors: (Constant), Experience, Effectiveness, Habit, Trust, Green Values

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	Upper Bound	Collinearity Statistics Tolerance	VIF
1	(Constant)	3,559	,542		6,561	<,001	2,487	4,630		
	Habit	-,011	,060	-,013	-,185	,853	-,130	,108	,979	1,022
	Trust	,219	,055	,302	3,960	<,001	,110	,328	,889	1,125
	Green Values	,217	,095	,207	2,274	,024	,029	,406	,626	1,597
	Effectiveness	,016	,089	,016	,180	,857	-,159	,191	,668	1,498
	Experience	,052	,153	,025	,336	,737	-,251	,354	,960	1,042

a. Dependent Variable: Attitude

Appendix G: Mediation Analysis (X=Green Consumer Values)

X=Attitude; Y= Intention; M=Green consumer values

Model: n=167, R=0.3093, R²= 0.0957, F (1,165) = 13.2324, p<0.001							
Path a	B	SE	β	T	Sig	95% Confidence interval	
						Lower limit	Upper limit
Green consumer values → Attitude	0.3459	0.0951	0.3093	3.6378	0.0004***	0.1582	0.5337

Model: n=167, R=0.6464, R²= 0.4179, F (2,164) = 43.0408, p<0.001							
Path b	B	SE	β	T	Sig	95% Confidence interval	
						Lower limit	Upper limit
Attitude → Intention	0.3208	0.0968	0.3301	3.3138	0.0011**	0.1296	0.5119

Model: n=167, R=0.5651, R²= 0.3193, F (1,165) = 55.3152, p<0.001							
Path c	B	SE	β	T	Sig	95% Confidence interval	
						Lower limit	Upper limit
Green consumer values → Intention	0.6142	0.0826	0.5651	7.4374	0.0000***	0.4511	0.7772

Model: n=167, R=0.6464, R²= 0.4179, F (2,164) = 43.0408, p<0.001							
Path c'	B	SE	β	T	Sig	95% Confidence interval	
						Lower limit	Upper limit
Green consumer values → Intention	0.5032	0.0819	0.4630	6.1454	0.0000***	0.3415	0.6649

Path ab	Effect	BootSE	95% Confidence interval	
			Lower limit	Upper limit
Indirect Effect	0.1110	0.0361	0.0470	0.1890
Standardised Indirect Effect	0.1021	0.0332	0.0437	0.1736

Appendix H: Mediation Analysis (X=Perceived Consumer Effectiveness)

X=Perceived consumer effectiveness, Y=Intention, M=Attitude

Model: n=167, R=0.2247, R^2= 0.0505, $F_{(1,165)}$ = 8.2806, p<0.01							
Path a	B	SE	β	T	Sig	95% Confidence interval	
						Lower limit	Upper limit
Perceived consumer effectiveness → Attitude	0.2415	0.0839	0.2247	2.8776	0.0045**	0.0758	0.4072

Model: n=167, R=0.5825, R^2= 0.3394, $F_{(2,164)}$ = 27.7974, p<0.001							
Path b	B	SE	β	T	Sig	95% Confidence interval	
						Lower limit	Upper limit
Attitude → Intention	0.3838	0.0928	0.3950	4.1343	0.0001***	0.2005	0.5671

Model: n=167, R=0.4373, R^2= 0.1912, $F_{(1,165)}$ = 28.2282, p<0.001							
Path c	B	SE	β	T	Sig	95% Confidence interval	
						Lower limit	Upper limit
Perceived consumer effectiveness → Intention	0.4566	0.0859	0.4373	5.3130	0.0000***	0.2869	0.6263

Model: n=167, R=0.5825, R²= 0.3394, F (2,164) = 27.7974, p<0.001							
Path c'	B	SE	β	T	Sig	95% Confidence interval	
						Lower limit	Upper limit
Perceived consumer effectiveness → Intention	0.3640	0.0765	0.3485	4,7597	0.0000***	0.2130	0.5671

Path ab	Effect	BootSE	95% Confidence interval	
			Lower limit	Upper limit
Indirect Effect	0.0927	0.0387	0.0285	0.1780
Standardised Indirect Effect	0.0888	0.0351	0.0278	0.1645